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Does Money Relieve Depression?
Evidence from Social Pension Eligibility

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ABSTRACT

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We estimate the impact of receiving pension benefits on mental well-being using China's New Rural Pension Scheme launched in 2010, the largest pension program in the world. More than four hundred million Chinese have enrolled in the program, and the program on average amounts to one fifth of pensioners' earned income. We find a salient increase in pension benefits and poverty alleviation around the pension eligibility age cut-off. Employing an instrumental variable approach to a national sample of the China Family Panel Studies, our empirical strategy overcomes the endogeneity of pension receipt that prevents us from identifying the causal effect of income change on mental health as measured by the full version of CES-D and depressive symptoms. Results reveal a sizeable reduction in depression susceptibility due to pension income. The improvement in mental health is larger for vulnerable populations with financial and health constraints. We further discuss potential pathways through which pension may affect mental health.

JEL Classification: H55, I18, I38, J14

Keywords: pension income, depression, mental health, older populations

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1. INTRODUCTION

Mental health is an important component of overall health status. Mental disorders are among the most common causes of low quality of life, high disability and death (Fiske et al. 2009; Byers et al. 2012). Mental disorders account for a large share of disability-adjusted life years and therefore the overall global burden of disease (Collins et al. 2011). Meanwhile, mental health plays an important role in maintaining good physical health.[1]

The effect of socioeconomic status (hereafter SES) on mental health has long been an important topic open for investigation.[2] Early social epidemiologic studies found strong associations between SES and a wide range of mental health measures in a large number of countries. Some have gone beyond positing just an association between SES and mental health and have suggested that there may be a causal relationship after controlling extensively for health behavior and other observable determinants of health (Dohrenwend 1975; Belle 1990; Marmot 1994). However, it is still unknown whether a causal relationship exists.

Resolving the causal debate is important as a better understanding of the causes of the SES-mental health gradient may lead to the development of more effective policy interventions. However, credibly establishing any of the causal pathways between SES[3] and mental 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 more income, then strategies, such as directly targeting health behavior, may be more appropriate. If, on the other hand, the gradient arises primarily because more income causes better health, policies should focus on promoting public health through making more economic resources available. Second, unobserved factors, such as genes and social trust, may affect both income and health and therefore bias our estimations. Third, compared to conventional policy targets, such as physical health, cognitive ability or economic behavior, mental health status is self-reported and often depends more on the context,

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[1] Mental illnesses, such as depression and anxiety, often affect physical health through delinquent behavior, suicide, substance use, and limit one's ability to participate in health-promoting behaviors. In turn, problems with physical health, such as chronic diseases, can have a serious impact on mental health and decrease a person's ability to participate in treatment and recovery (Lando et al. 2006; National Research Council and Institute of Medicine 2009).

[2] More broadly, the existence of a positive correlation between health and income, often referred to as the income-health gradient, has been well documented, while the underlying causal mechanisms remain less understood (Marmot, 2002; Smith, 1999; Deaton, 2002).

[3] In the following discussions we use income as a proxy of SES.

indicating that measurement errors likely exist.

In an attempt to identify the causal impact of income on mental health, studies use various exogenous variations in income. For example, Ettner (1996) uses state unemployment rate, work experience, parental education, and spousal characteristics as instrument variables (hereafter IV) for income. However, the instruments employed may not satisfy the exclusion restriction, i.e. the instruments may directly affect mental health and therefore invalidate the IV strategy. Moreover, the mental health consequences of events such as a financial crisis (Friedman and Thomas 2008), migration to regions of higher living standards (Stillman et al. 2009), job displacement (Sullivan and Wachter 2009) or winning a prize (Oswald and Rablen 2008) 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) suggest that non-pecuniary mechanisms are likely at work.

Some studies make use of lottery winning as an exogenous shock and find that people exhibit better mental health after winning the lottery (Smith, 1999; Lindahl, 2005; Gardner and Oswald 2007; Apouey and Clark 2015; Cesarini et al. 2014). However, 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.

Some other studies use inheritance as an income shock. However, 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. Moreover, both lottery winning and inheritance are in the form of a lump-sum transfer, which may affect mental health differently than in the form of an annuity due to a violation of fungibility (Thaler 1990).

Studies also explore other exogenous changes in income in their empirical identifications, including 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).

While some of the existing studies find positive linkages between income and mental health, many fail to find compelling evidence (Brickman et al. 1978; Adams et al. 2003; Meer et al. 2003; Frijters et al. 2005; Adda et al. 2009; Stowasser et al. 2011; Kuhn et al. 2011; Kim and Ruhm 2012), and a few even reported small negative effects (e.g. Snyder and Evans 2006).

Moreover, the rapid aging of the world population further raises the importance of improving mental health in older ages, because older adults suffer the most from mental illness and have the highest suicide rate among all age groups. The literature on the causal impact of income on mental health, especially in older ages, has been limited to the developed country context.[4] 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 due to depression they lose four times more disability–adjusted life years (DALYs) than people in high-income countries (Mathers et al. 2008). Despite the staggeringly high costs, investment in mental illness prevention and treatment remains relatively low in LMICs (Collins et al., 2011).

This paper provides one of the first pieces of evidence for a causal relationship between income and mental health for older persons in the developing world. We use the largest pension program in the world – China's New Rural Pension Scheme (hereafter NRPS). The pension payment in China is much smaller than that in many other developing countries, such as South Africa (Lund 2007). However, even modest economic resources have potential to improve mental health. Our analysis focuses on people in their 50s and 60s, saliently younger than subjects in the closest literature on social pensions and mental health (Golberstein 2015). Moreover, while Golberstein (2015) relies on a social security notch that generates disparities in pension benefits across a number of birth cohorts, our variation for identification comes from a sharp change in pension benefits around a cut-off age. Specifically, pensioners with rural

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[4] For example, Golberstein (2015) utilizes the Social Security Notch to examine the impact of social security income on mental health among the oldest old in the U.S.

household registration (*Hukou*) in China can start to receive a basic public pension after age 60, which is not tied to their retirement decisions. The universal age eligibility provides exogenous variations in pension receipt and pension benefits, which allows us to identify their effects on mental health using an IV approach.

We make use of the 2012 China Family Panel Studies (hereafter CFPS). To our knowledge, mental health indicators in the CFPS, i.e. the 20-item full version of Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff 1977), provide the most comprehensive measures of mental well-being among all the available national samples in China. The CES-D enables us to measure both continuous changes in mental health and dichotomous changes in depressive symptoms.

We first document substantial increases in the rate of pension receipt and pension benefits, as well as a significant decline in the poverty rate immediately above the pension eligibility age. Our results suggest that the pension generates a sizable improvement in mental health, and that this impact is unevenly distributed. Specifically, pension receipt disproportionally improves the mental health of those in the lower tail of the SES distribution. We also found that the positive effect of pension receipt on mental health is stronger among males and in areas with earlier pension roll-out.

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

2. CHINA'S NEW RURAL PENSION REFORM

Against the backdrop of rapid economic growth, China is aging rapidly. A combination of an increasing life expectancy and a declining fertility rate has led to an acceleration of demographic aging in China, following the introduction of the One-Child Policy in the 1970s. However, the formal social safety net for rural elderly population was almost non-existent prior to 2009. To provide a robust system of old-age support, in 2010 China launched a pension program, the NRPS, for rural residents. By 2012, NRPS covered more than four hundred million Chinese, among whom almost ninety million had reached the eligible age of 60 for pension payment. Whether an individual is eligible to receive this pension does not depend on the

composition of their extended family or their past work history.

Under the NRPS, there are two types of pension payments, i.e. a basic noncontributory pension and an individual pension account. Both are paid to participants when they reach age of sixty. Firstly, a basic pension, financed by the collective fund, is available to all residents and does not require any premium contributions. Many provinces set 55 CNY[5] per month per person as the basic pension benefit, while a few rich provinces, such as Beijing and Tianjin, set the basic pension benefits to be 150-360 CNY per month per person. Since people who were older than age 60 when the NRPS was rolled out have no individual account, the basic pension is the only form of payment they can obtain.

Secondly, the NRPS stipulates that young adults below age 45 must contribute for at least 15 years to be eligible for pension. Contributions accumulate in the individual account, which are drawn down when the participant turns age of 60. The middle age group (ages 45-59.99) may contribute for any length of time to be eligible for individual contribution pension plan. According to the guidance released by the State Council of China, there are five categories of individual premiums: 100, 200, 300, 400, and 500 CNY per year per person. While some provinces have additional categories of individual premiums at 600, 700, 800 CNY or higher per year per person, a majority of participants only choose to pay the lowest level of premium, i.e., 100 CNY (Lei et al. 2013).[6]

The financing of the pension payment consists of three parts, i.e. an individual premium, a local government subsidy, and a central government subsidy. Besides subsidies from the central government to finance the basic noncontributory pension, people pay pension premiums towards their individual account. Depending on the individual premium contribution, provincial and county governments jointly finance subsidies, starting at 30 CNY, into the individual account.

The design of NRPS results in a jump in the rate of pension receipt (Figure 2a) and pension income (Figure 2b) at age 60. The NRPS beneficiaries receive basic pension payment between 660 and 4,320 CNY per year per person, depending on the province in which pensioners reside. The payment can also be higher for seniors who

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[5] 1 U.S. Dollar (USD) $\approx$ 6 Chinese Yuan (CNY).

[6] The fact that most participants contribute the lowest level of premium before age 60 and receive at least several times as much when they reach age 60 suggests that the positive effect of pension on mental health we identify should mostly come from receiving pension benefits, rather than from stop paying for pension premium.

invested in their individual account before age 60. For those who receive the payment, the pension accounts for roughly 20 percent of earned income.[7]

The NRPS may demonstrate heterogeneous impacts given China's large economic disparities. 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). Since the older population on average earns much less than the younger population, the NRPS may increase income of older persons by 7-8 times, generating a large impact, especially in regions that are lagging behind (Zhang et al., 2013).

3. METHODS

3.1 Data

We use the China Family Panel Studies (CFPS), a nationally representative longitudinal survey, collected by Peking University.[8] The baseline survey in 2010 interviewed over 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 nonexistent in most of the counties in 2010 covered by the CFPS, only the 2012 survey is utilized in our analysis.[9]

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-question CES-D measures 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)",

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[7] Calculating using CFPS, earned income is net of deductions for transfer income (including transfer from government, friends, relatives, and other channel) 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 1227.8 CNY (column (2) of Table 1, 313.1 / 0.255 = 1227.8 CNY).

[8] See www.isss.edu.cn/cfps/EN for a more detailed introduction of CFPS.

[9] Moreover, the 2010 wave CFPS only measured mental health using a six-item version of CES-D, preventing us from identifying important dichotomous indicators of depression, i.e. depressive symptoms and severe depression, we use in this analysis.

"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 (Figure 4). Two binary indicators, depressive symptoms and severe depression, are often used for the diagnosis of depression. An individual is diagnosed with depression if the CES-D total score is higher than 15 in the first indicator, or above 20 in the second indicator (Radloff 1977; Bailly et al. 1992). Figure 1 shows that higher income is associated with lower rate of depression using the CFPS. The trend is more salient for individuals in the low or median income groups. Figure 4 suggests that a substantial proportion of respondents suffer from depressive symptoms and severe depression.

3.2 Estimation Strategy

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

$$Y_i = \alpha_0 + \tau Pension_i + \sum_{j=1}^{k} \alpha_j \left(Age_i - 60.5\right)^j + X_i'\alpha + \delta D_i + \varepsilon_i \tag{1}$$

where Y_i denotes mental health. τ identifies the effect of $Pension_i$, denoted by a dichotomous variable *whether receives pension* and a continuous variable *pension income in the past year*. We control for the polynomial (order k=3) of age normalized by pension eligibility age, baseline characteristics X_i, and county fixed effects D_i. X_i includes gender, ethnicity, cadre and party membership status, year of education, and marital status. The estimates are clustered at the county level. Results are adjusted for sampling weights provided by the CFPS survey.

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 get around the reverse causation and omitted variable bias and obtain unbiased and consistent estimates, we utilize a sharp change in the eligibility of pension benefits to instrument for actual pension receipt status. Though age 60 is the cut-off for pension eligibility according to the policy, the actual payment can be distributed a few months later. In the CFPS national sample, age 60.5 has the largest

jump in the rate of pension receipt and pension benefits.[10] Specifically, Figure 2 plots the sample mean of pension receipt status by normalized age, where 0 represents age 60.5. We observe a substantial jump in the average rate of pension receipt from almost zero to 0.6-0.8 (Figure 2a) and a sharp increase in the average pension benefits from less than 100 CNY to 700 CNY below and above the age 60.5 cut-off (Figure 2b).

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:

$$Pension_i = \beta_0 + \lambda Eligible_i + \sum_{j=1}^{k} \beta_j \left(Age_i - 60.5\right)^j + X_i'\eta + \phi D_i + e_i \qquad (2)$$

where $Eligible_i$, an instrument for $Pension_i$, is a binary variable indicating whether individual i is over age 60.5. $Eligible_i$ must be strongly correlated with the endogenous explanatory variable $Pension_i$, conditional on other covariates. In the meantime, $Eligible_i$ can only be correlated with mental health through its impact on pension receipt or pension benefits. Though this latter exclusion restriction condition is not directly testable, we follow existing studies to flexibly specify beneficiary age to disentangle the effect of pension eligibility from underlying age or cohort trends in pension benefits and in mental health (Moran and Simon 2006; Goda 2011). Specifically, we use the flexible specification of cubic individual age. Our key assumption, which seems quite plausible, is that, conditioned on the flexible function of own age, people younger and older than age 60.5 have similar mental health.

The instrumental variable (IV) approach identifies the local treatment effect of pension. This effect is analogous to an *intent to treat* (ITT) parameter of a randomized control trial where the treatment is to receive pension. However, because of "lack of compliance", a few people assigned to treatment by passing the eligible age did not end up receiving pension, while a few people assigned to control group due to their younger age actually received pension. The IV approach only includes individuals compliant with pension receipt rules, i.e. individuals who do not receive pension if not eligible (below age 60.5) and receive pension if eligible (above age 60.5).

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[10] Zhang et al. (2013) adopt age 60.75 cut-off using the China Health and Retirement Longitudinal Study. Our age cut-off is slightly different, possibly due to different sampled communities and more recent 2012 CFPS data collection, which include more communities in which the NRPS was rolled out.

4. EMPIRICAL RESULTS

4.1 Main Results

Table 1 shows descriptive statistics of pension status, mental health, SWB indicators, and covariates in the analysis. Comparing their average values between age cohorts 60.5-70.5 and 50.5-60.5, the former group demonstrates a substantially higher rate of pension receipt and pension income. However, mental health status seems not significantly better in the former group. Next, we conduct more rigorous regression analyses to disentangle the effect of pension from the aging trend and other age cohort confounders.

A first stage estimation is implemented to test the correlation between age eligibility and pension status, including the likelihood to receive pension and the size of pension benefits. Results presented in Table 2 show that reaching age 60.5 increases the rate of pension receipt by 48.6 percentage points and pension income by 484.4 CNY. Consistent with Figure 2, these results indicate that pension age eligibility is a strong instrument for both pension receipt and pension benefits. Consequently, the receipt of pension significantly alleviates poverty according to the $1.25 international poverty line, while no such effect is found for the $2 international poverty line (Figure 3).

The effects of pension receipt and pension income on mental health are presented in Table 3. Pension significantly improves mental health, especially depressive symptoms. The CES-D score of pensioners is, on average, .34 points lower than that of non-pensioners in the OLS regression, while it is 2.10 points lower in the IV estimations. The rate of depressive symptoms is 16.4 percentage points lower among pensioners. A 100 CNY rise in the annual pension income would lower the CES-D score by 0.212 and decrease the probability of depressive symptoms by 1.7 percent.[11]

Considering that the lowest pension payment in the NRPS is 660 CNY and that pension beneficiaries on average receive 1227.8 CNY (column (2) of Table 1, 313.1/0.255=1227.8 CNY), the total effect of the pension scaled on per 100 CNY basis is sizable. On average, receiving pension reduces the prevalence of depressive symptoms by 40 percent (16.4/40.5). This is a fairly large effect, considering that treatment, either by medication or therapy, can reduce the prevalence of mental

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[11] The results hold when we restrict the sample to the 55.5-65.5 age cohorts. This set of results are available upon request.

distress by 70 - 93.5 percent in low- and middle-income countries.

Our main findings in Table 3 also show that pension receipt decreases CES-D by .25 standard deviations and decreases the depression symptom by .33 standard deviations. 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 one third of that created by the immigration from Tonga to New Zealand (Stillman et al. 2009), and 2-4 times of that created by the re-employment after involuntary job loss in the U.S. (Mandal and Roe 2008).

Our estimations are conservative and tend to underestimate the real effects. First, any anticipation effect of pension among those below the pension eligibility age, if exists, may dampen the impact of pension on mental health. However, people with various binding constraints, such as low income and poor health status, are less likely to react to the policy in advance as their ability to borrow from future is restricted. In section 4.2, we test the effects in subsamples of individuals with various binding constraints. Second, consistent with Edmonds et al. (2005), we find that the impact of pension receipt may take time to be realized, similar to the delays of the impact of lottery winning (Winkelmann et al. 2011; Kuhn et al. 2011). In Table 4, we show that significant effects of pension receipt are only observed in the counties that have on average more than one year of the NRPS implementation.

4.2 Heterogeneous Effects

In this section, we discuss the heterogeneous effects of pension on mental health in several subsamples by income, education, physical health, gender, and various aspects that comprise the CES-D measures.

Due to the large income disparities in China, pension payment may account for a larger share of income for the poor, leading to heterogeneous impacts among the poor and the rich. We divide the whole sample into three income groups. Though the effects are less precisely estimated due to the smaller sample size, Panel A of Table 5 demonstrates that improvement in mental health from pension receipt mainly comes from the two lower income groups.

Nearly half of the rural respondents aged 50-70 in the CFPS national sample are illiterate or semi-illiterate, defined as not completing primary education. We divide the sample into three groups. The first group is composed of individuals who are illiterate or semi-illiterate. The second group is composed of individuals who have

completed only primary education. The third group is composed of individuals who have completed secondary education. Panel B of Table 5 shows that pension income is the most depression symptom reducing for the least educated group, which is consistent with recent evidence in the U.S. (Ayyagari 2015).

Panel C of Table 5 tests whether binding physical health constraints affect the impact of pension receipt on mental health. We divide the sample by chronic disease status in the past 6 months. Results indeed show a larger impact of pension on mental health among those who suffer from chronic diseases.

Given evidence of gender differences in mental health (Gove 1984) and differential pension effect by gender (Duflo 2000, 2003), we examine whether mental health of males and females are affected differently. Panel D of Table 5 shows that mental health status among males is improved more by pension receipt.

Looking into the composition of CES-D, Table 6 illustrates that 19 out of all 20 items are improved. Five of the 19 items are significantly improved, which include "I thought my life had been a failure", "I felt fearful", "I had crying spells", "I felt that people disliked me", and "I could not get 'going'". 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 uses may to some extent affect the impact identified. Ideally, we should consider using the full set of questions to comprehensively assess the mental health impact in all dimensions.

5. POTENTIAL MECHANISMS

The Grossman model of health capital (1972a, 1972b) provides a conceptual basis for analyzing the relationship between income and mental health.[12] 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. engaging in unhealthy behaviors and lifestyle in general, such as smoking

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[12] 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.

and alcohol drinking) is sufficiently high.

Though the original Grossman model does not make unambiguous predictions about the sign of the effects of an income shock on mental health, it is worthwhile to think about channels through which income shocks may affect mental health investment and health outcomes and, in particular, which of these channels are likely to apply to the Chinese context.

Grossman's framework suggests that pension payments may affect mental health through at least three plausible channels: (i) changes to lifestyle factors, such as independent living, service consumption, leisure time, and social network connectedness; (ii) health investments, such as nutritional intake and medical treatment; (iii) reduced financial stress, increased self-esteem and life satisfaction, and improved confidence in future.

Firstly, elderly individuals who want to live independently and are able to do so will likely have better mental health. In part, this is because individuals who are able to live independently may have a greater sense of self-actualization. In addition, the atomization of extended families may reduce family conflicts (The Economist 2014). Recent studies show that the NRPS promotes independent living among the elderly (Chen et al. 2016). As a result of pension to elderly parents, children are more motivated to move out (Chen 2015) or even migrate away from the home county (Chen 2016). Both service consumption and independent living due to pension may result in changes in lifestyle, such as through less arduous household chores, more leisure time and more connectedness with friends and communities, which are all protective factors for mental well-being (Patel et al. 2007; Devoto et al. 2012).

Secondly, health care resources are expensive in LMICs where individuals often rely on private out-of-pocket medical care. More income reduces the relative cost of inputs for health, releases the budget constraint, and promotes the use of basic health care services. Studies show that more income improves mental health via improved nutritional intake and protective behavior (Patel et al. 2007), and formal medical treatment (Cesarini et al. 2014; Chen 2015).

Thirdly, pension income may improve mental health through reduced psychosocial stress and adverse moods associated with financial hardship (Conger et al. 1994; Marmot 2005). Cesarini et al. (2014) find that more income causes a small reduction in the consumption of mental health drugs, especially drugs used to treat anxiety and sleep difficulty. The adverse effects of financial insecurity fall

disproportionately on the poorer segments of the society. Fernald and Gunnar (2009) find that poverty alleviation efforts reduce depressive symptoms by reducing the frequency of stressful situations and increasing the sense of control.

Pension income may improve mental well-being by increasing an individual's self-esteem and self-satisfaction (Baird et al. 2013). Table 7 shows that the pension benefits indeed promote life satisfaction. Moreover, the effect on self-satisfaction is larger than that on family satisfaction, which is consistent with the fact that pension benefits from the NRPS is individual-based.

Pension income may also improve mental health through insuring against uncertainty in older ages, especially in regions where income smoothing and risk coping mechanisms are often limited. While the short time period covered by the CFPS national survey prevents us from measuring economic volatility in older ages and directly testing this mechanism, Table 7 shows that pensioners become more confident about future upon receiving pension.

6. **CONCLUSIONS AND DISCUSSION**

Employing the IV strategy to the recently launched largest pension program in the world, this paper provides new evidence for a positive causal relationship between income and mental health in older ages. China's new rural pension program offers a modest but appealing source of income to elderly individuals over age 60 and helps reduce the elderly poverty rate. This program also is associated with significant mental health benefits, especially for individuals with financial and health constraints.

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 soon after NRPS roll-out, we may have to wait longer to observe its potential impact on physical health.

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 part 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, the

policymakers in China, as well as those in many other developing countries, are seeking to improve health and nutrition status of disadvantaged groups. The heterogeneous effects identified in this paper provide a reference in the developing contexts. Fourth, this research draws attention to the poor mental health of the older population and social pensions that can be used to make progress in this domain.

Our findings suggest that even a relatively modest pension may help improve the mental health of Chinese population. Meanwhile, given that the cost of mental disorders 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.

More recently, Chinese government has implemented the new urban pension scheme (NUPS), raised the government subsidies for the NRPS, and integrated NUPS and NRPS as one unified pension system. Our future work includes evaluating more comprehensive socioeconomic impacts of this growing pension system.

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Figure 1 Income and Mental health
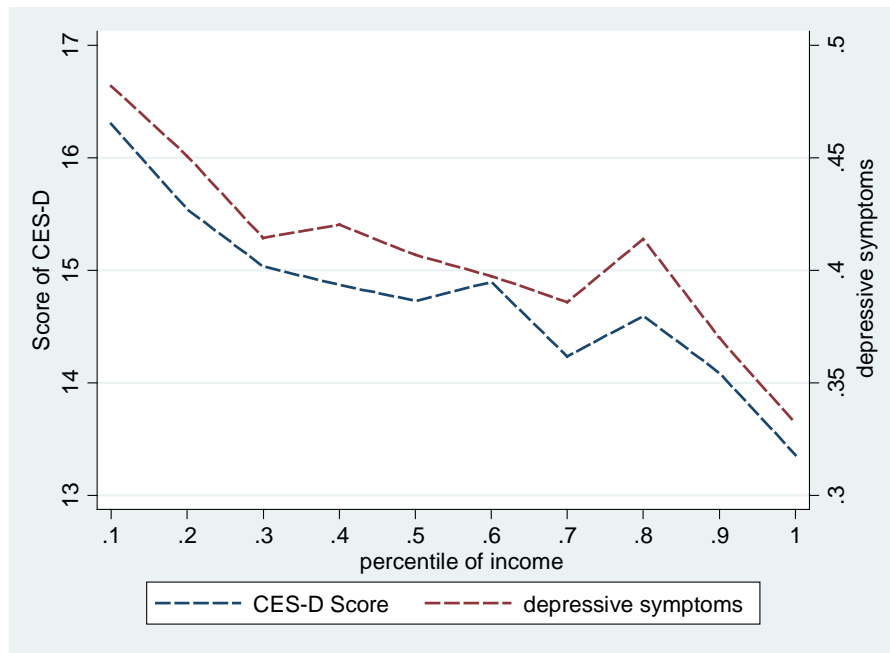
Notes: This Figure uses income information collected in the 2012 wave, adjusted to 2010 constant prices. The age range is limited to [50.5, 70.5]. The left vertical axis is CES-D score, and the right vertical axis is rate of depressive symptoms.

Figure 2a Discontinuities of Pension Receipt
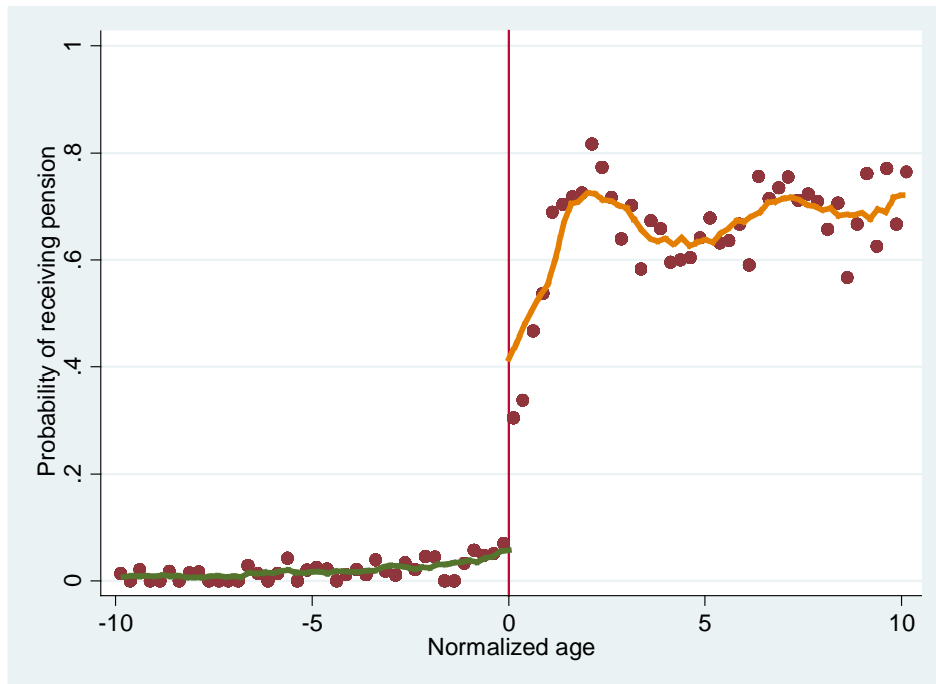
Figure 2b Discontinuities of Pension Income
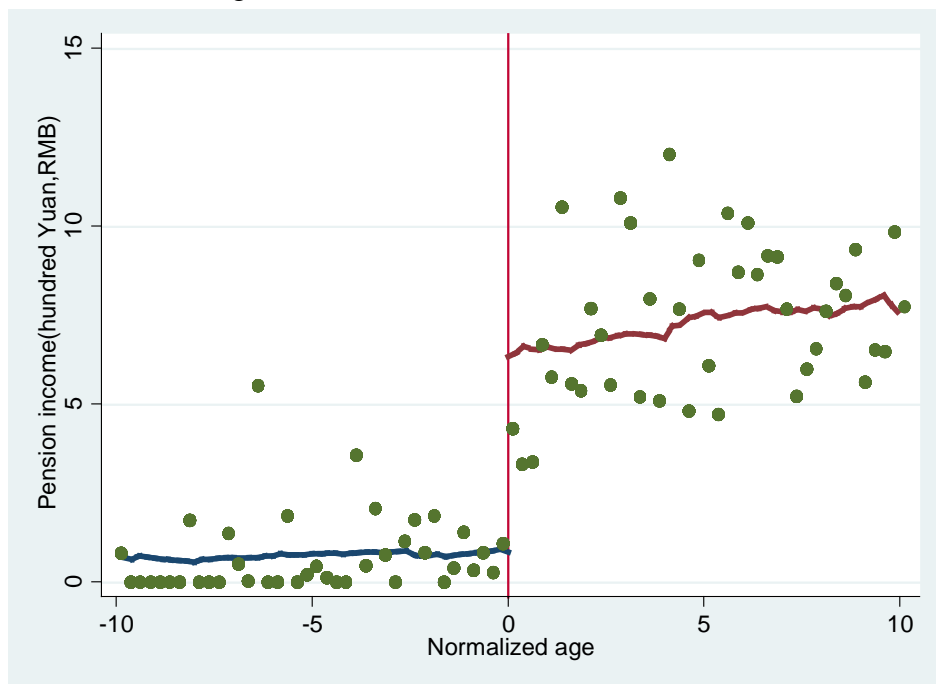
Source: CFPS 2012

Notes: The dots represent rates of pension receipt by 0.25 year bins. In the X-axis, the 0 marks age 60.5. The line on both sides of the cut-off is fitted using polynomial regression of degree 0.

Figure 3 Changes in Poverty Rate over the Pension Eligibility Age

Notes: The age cut-off 0 marks age 60.5. Income (in CNY) is transformed to 2010 constant prices. The lines are fitted using polynomial regression of degree 0.

Figure 4 Density of CES-D score

Notes: The blue and red lines separately represent the thresholds for depressive symptoms and severe depression, i.e., 16 and 21 of CES-D score.

Table 1 Summary Statistics

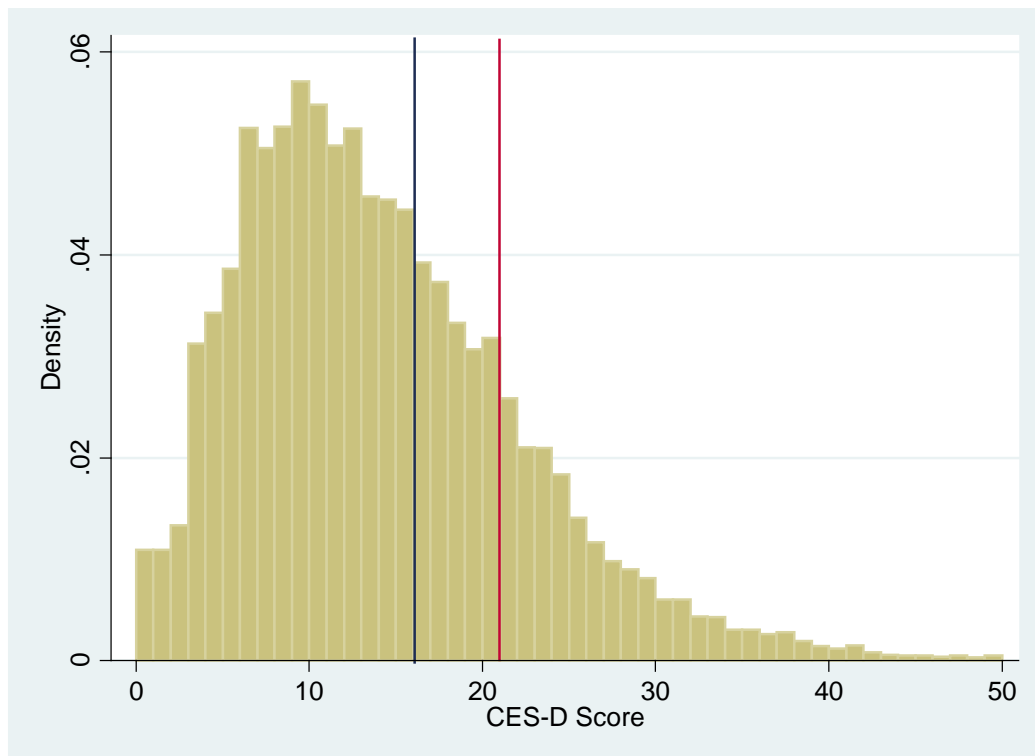| dependent variable	All	[-10yr,10yr]	[-10yr, 0)	[0, 10yr]	Diff (4)-(3)
	(1)	(2)	(3)	(4)	(5)
CES-D					
total score of CES-D	13.60	14.70	14.67	14.76	0.086
	(8.048)	(8.549)	(8.562)	(8.530)	(0.257)
depressive symptoms	0.353	0.405	0.409	0.399	-0.010
	(0.478)	(0.491)	(0.492)	(0.490)	(0.015)
severe depression	0.182	0.231	0.229	0.236	0.007
	(0.386)	(0.422)	(0.420)	(0.425)	(0.013)
Subjective Well-being					
confidence	3.633	3.385	3.409	3.345	-0.064
	(1.144)	(1.184)	(1.182)	(1.186)	(0.036)
self-satisfaction	3.299	3.327	3.272	3.416	0.144***
	(1.068)	(1.088)	(1.090)	(1.077)	(0.033)
family satisfaction	3.431	3.426	3.385	3.493	0.108***
	(1.064)	(1.084)	(1.084)	(1.080)	(0.033)
Pension					
pension receipt	0.123	0.255	0.021	0.641	0.621***
	(0.328)	(0.436)	(0.142)	(0.480)	(0.009)
pension income	1.533	3.131	0.725	7.090	6.365***
(100 CNY)	(10.68)	(12.05)	(8.675)	(15.34)	(0.351)
Poverty Status					
poverty(1.25$/day)	0.155	0.255	0.148	0.216	0.068***
	(0.362)	(0.436)	(0.355)	(0.412)	(0.011)
poverty(2$/day)	0.247	3.133	0.242	0.328	0.087***
	(0.431)	(12.06)	(0.428)	(0.470)	(0.013)
Covariates					
age	46.91	59.27	55.95	64.74	8.791***
	(14.58)	(5.117)	(2.786)	(2.903)	(0.085)
male	0.473	0.494	0.483	0.512	0.029
	(0.499)	(0.500)	(0.500)	(0.500)	(0.015)
Han	0.911	0.918	0.915	0.924	0.009
	(0.285)	(0.274)	(0.279)	(0.265)	(0.008)
CCP membership	0.044	0.061	0.057	0.068	0.011
	(0.205)	(0.240)	(0.232)	(0.251)	(0.007)
married	0.856	0.899	0.931	0.847	-0.084***
	(0.351)	(0.301)	(0.254)	(0.360)	(0.009)
year of education	5.753	4.139	4.793	3.062	-1.731***
	(4.348)	(4.212)	(4.486)	(3.461)	(0.124)
NCMS	0.893	0.921	0.920	0.922	0.001
	(0.309)	(0.270)	(0.271)	(0.269)	(0.008)
chronic disease	0.116	0.163	0.150	0.184	0.034**
	(0.321)	(0.369)	(0.357)	(0.388)	(0.011)
living with children	0.750	0.679	0.722	0.607	-0.116***
	(0.433)	(0.467)	(0.448)	(0.489)	(0.014)
nursed by children	0.141	0.231	0.196	0.289	0.093***
	(0.348)	(0.422)	(0.397)	(0.454)	(0.013)
total assets (10,000 CNY)	24.52	22.57	24.53	19.35	-5.177**
	(58.45)	(54.68)	(63.54)	(35.36)	(1.645)
migration ratio	0.097	0.108	0.119	0.089	-0.030***
	(0.194)	(0.182)	(0.189)	(0.170)	(0.005)
N	14765	5035	3119	1946	

Source: CFPS 2012

Notes: [-10yr, 10yr], [-10yr, 0) and [0, 10yr] mean years relative to age 60.5 cutoff; N is sample size. Standard errors are reported in the parentheses. Respondents are asked to report confidence in a scale of 1-5 ranging from not confident (very dissatisfied) to very confident (very satisfied).

Table 2 First Stage: The Effect of Being over Eligible Age on Pension Receipt

VARIABLES	Pension Receipt (0/1)	Pension income (100 CNY)
	(1)	(2)
over eligible age	0.486***	4.844***
	(0.020)	(0.732)
Age	0.024***	0.252**
	(0.003)	(0.127)
age^2	0.001***	0.006
	(0.000)	(0.006)
age^3	-0.000***	-0.001
	(0.000)	(0.001)
Male	-0.016*	-0.931***
	(0.009)	(0.334)
Han	0.007	0.113
	(0.022)	(0.814)
CCP membership	0.030*	-0.045
	(0.018)	(0.657)
married	0.010	0.961*
	(0.014)	(0.519)
year of education	0.002	0.079*
	(0.001)	(0.043)
NCMS	0.069***	-0.538
	(0.016)	(0.580)
chronic disease	-0.000	-0.176
	(0.011)	(0.413)
living with children	-0.017*	-0.355
	(0.010)	(0.367)
nursed by children	0.024**	1.020**
	(0.011)	(0.398)
total assets	0.000	0.005*
	(0.000)	(0.003)
migration ratio	0.015	-0.065
	(0.026)	(0.931)
County FE	Yes	Yes
Constant	0.194***	0.885
	(0.052)	(1.874)
Observations	4,925	4,925
R-Squares	0.591	0.273

Notes: F-tests for "over eligible age" are respectively 582.62 and 43.82 for pension receipt and pension income, which reject the null hypothesis that the instrument variable is weak. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are reported in the parentheses.

Table 3 Main Results: The Effect of Pension Receipt on Mental Health

dependent variable	Pension receipt (0/1)		Pension income (100 CNY)	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
CES-D				
total score of CES-D	-0.341	-2.095*	0.010	-0.212*
	(0.369)	(1.108)	(0.011)	(0.117)
depressive symptoms	-0.011	-0.164**	-0.000	-0.017**
	(0.022)	(0.066)	(0.001)	(0.007)
severe depression	-0.003	-0.070	0.001	-0.007
	(0.019)	(0.058)	(0.001)	(0.006)
N	4737	4737	4737	4737

Notes: Covariates include age, age squared, age cubed, gender, ethnicity, CCP membership, year of education, marital status, NCMS, chronic disease, living arrangement, whether nursed by children after falling ill, total assets, share of family members migrated, and county fixed effect. The instrument variable for pension receipt and pension income is whether an individual is over the eligible age 60.5 for pension benefits. Results in column 2 and column 4 are 2SLS estimates. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are reported in the parentheses.

Table 4 The Effect of Pension Receipt on Mental Health
(by Roll-out Timing, 2SLS Estimates)

	Pension receipt (0/1)			Pension income (100 CNY)		
	(1)	(2)	(3)	(4)	(5)	(6)
dependent variable	early	Middle	late	early	middle	late
CES-D						
total score of CES-D	-3.824**	-1.262	-1.578	-0.373*	-0.123	-0.245
	(1.685)	(1.893)	(3.054)	(0.199)	(0.189)	(0.479)
depressive symptoms	-0.199**	-0.081	-0.209	-0.019*	-0.008	-0.032
	(0.099)	(0.114)	(0.182)	(0.011)	(0.011)	(0.030)
severe depression	-0.140*	-0.036	-0.035	-0.014	-0.003	-0.005
	(0.085)	(0.098)	(0.167)	(0.009)	(0.010)	(0.026)
N	1301	1558	1113	1301	1558	1113

Notes: 2SLS estimation results are reported. The average length of NRPS roll-out time in the three groups are 30.5, 15.4, and 7.1 months, respectively. Since roll-out timing is at the year/month level, the three subsamples have similar (but not the same) number of observations. Other notes follow Table 3.

Table 5 Heterogeneous Effects of Pension Receipt on Mental health
(2SLS Estimates)

	Pension receipt (0/1)			Pension income (100 CNY)			Pension receipt (0/1)		Pension income (100 CNY)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Panel A: by three income groups						Panel C: by chronic diseases			
dependent variable	low	middle	high	low	Middle	high	w/o	w	w/o	w
total score of CES-D	-2.571	-3.627	-0.505	-0.339	-0.398	-0.040	-1.441	-5.675**	-0.152	-0.550*
	(2.082)	(2.214)	(1.683)	(0.285)	(0.283)	(0.135)	(1.229)	(2.742)	(0.133)	(0.287)
depressive symptoms	-0.118	-0.251*	-0.047	-0.016	-0.028	-0.004	-0.125*	-0.377**	-0.013	-0.037**
	(0.124)	(0.134)	(0.100)	(0.017)	(0.018)	(0.008)	(0.074)	(0.160)	(0.008)	(0.017)
severe depression	-0.084	-0.183	0.044	-0.011	-0.020	0.003	-0.061	-0.146	-0.006	-0.014
	(0.111)	(0.118)	(0.084)	(0.015)	(0.015)	(0.007)	(0.063)	(0.152)	(0.007)	(0.015)
N	1545	1537	1546	1545	1537	1546	3963	774	3963	774
	Panel B: by education						Panel D: by gender			
	illiterate	primary edu	secondary edu	illiterate	primary edu	secondary edu	female	male	female	Male
total score of CES-D	-2.748*	-0.632	-0.815	-0.315	-0.068	-0.071	-1.308	-2.227	-0.219	-0.176
	(1.654)	(1.771)	(2.420)	(0.205)	(0.193)	(0.212)	(1.728)	(1.397)	(0.305)	(0.113)
depressive symptoms	-0.212**	-0.031	-0.059	-0.024**	-0.003	-0.005	-0.081	-0.205**	-0.014	-0.016**
	(0.095)	(0.108)	(0.151)	(0.012)	(0.012)	(0.013)	(0.099)	(0.088)	(0.017)	(0.007)
severe depression	-0.101	-0.102	0.044	-0.012	-0.011	0.004	-0.076	-0.030	-0.013	-0.002
	(0.088)	(0.095)	(0.122)	(0.010)	(0.011)	(0.011)	(0.092)	(0.070)	(0.016)	(0.006)
N	2074	1254	1409	2074	1254	1409	2403	2334	2403	2334

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 3.

Table 6 The Effect of Pension Receipt on Mental health
(by Each Item in the CES-D Scale, 2SLS Estimates)

	Pension receipt (0/1)		Pension income (100 CNY)	
	Coef	SE	Coef	SE
CES-D questions				
1. I was bothered by things that usually don't bother me.	-0.067	0.115	-0.007	0.012
2. I did not feel like eating; my appetite was poor.	-0.050	0.111	-0.005	0.011
3. I felt that I could not shake off the blues even with help from my family or friends.	-0.007	0.100	-0.001	0.010
4. I felt that I was just as good as other people.	-0.188	0.142	-0.019	0.015
5. I had trouble keeping my mind on what I was doing.	-0.072	0.118	-0.007	0.012
6. I felt depressed.	-0.100	0.112	-0.010	0.011
7. I felt that everything I did was an effort.	-0.087	0.127	-0.009	0.013
8. I felt hopeful about the future.	-0.129	0.149	-0.013	0.015
9. I thought my life had been a failure.	-0.232**	0.112	-0.023**	0.012
10. I felt fearful.	-0.160*	0.089	-0.016*	0.009
11. My sleep was restless.	0.108	0.126	0.011	0.013
12. I was happy.	-0.127	0.138	-0.013	0.014
13. I talked less than usual.	-0.124	0.119	-0.012	0.012
14. I felt lonely.	-0.171	0.105	-0.017	0.011
15. People were unfriendly.	-0.026	0.09	-0.003	0.009
16. I enjoyed life.	-0.108	0.136	-0.011	0.014
17. I had crying spells.	-0.196**	0.087	-0.020**	0.009
18. I felt sad.	-0.038	0.095	-0.004	0.010
19. I felt that people disliked me.	-0.170**	0.084	-0.017*	0.009
20. I could not get "going."	-0.152*	0.083	-0.015*	0.009

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 3.

Table 7 Potential Mechanisms: Confidence in Future and Life Satisfaction

dependent variable	Pension receipt (0/1)		Pension income (100 CNY)	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
confidence in future	0.157***	0.457***	0.002	0.046***
	(0.054)	(0.162)	(0.002)	(0.017)
self-satisfaction	0.092*	0.468***	0.000	0.047***
	(0.050)	(0.149)	(0.001)	(0.017)
family satisfaction	0.090*	0.294**	0.001	0.030*
	(0.050)	(0.148)	(0.001)	(0.016)
N	4737	4737	4737	4737

Notes: Follow Table 3.