Will the Elderly Benefit from Public Pension Programs in a Developing Country? Understanding the Effects of China's Public Pension Program Expansion on Health Outcomes

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Introduction

Background

China is one of the world leading economies. Ranking the second in the world, China's GDP is $11.2 trillion in 2016, with a rapid annual growing rate through the past five years, around 6.7% to 7.9% (*World Bank Open Data*). However, with the world's largest population of almost 1.38 billion, China's GDP per capita remains in the tier of a middle income and developing country.

As a developing country with the world's largest population, China is aging at a more accelerated pace than the world average. According to the United Nations (1956, p. 27) calculation, China entered the rank of an aging society in 2005. This demographic transition happened within 40 years, compared to typical 100 years in developed countries such as the UK, the US, and the Nordic countries (Chen & Liu, 2009). According to the census in 2010, the population aged 60 and over accounted for 13.26%, the population aged 65 and over accounted for 8.87% (PCO & DPES, 2012). The median age in China was 37.0 in 2015, greater than the world average 29.6. The proportion of the population aged 60 and over in China will be 36.5% in 2050, much greater than the world average 21.5% (United Nations, 2015).

Furthermore, population aging in rural is even faster than in urban areas. In 1982, the proportion of the population aged 60 and over was 7.8% in rural and 7.1 % in urban areas, and rose to 13.7% and 12.1% respectively by 2005 (Cai, Giles, O'Keefe, & Wang, 2012). There are huge income, wealth and consumption inequalities between urban and rural areas (Chang, 2002; Gustafsson, Shi, & Zhong, 2006; Kanbur & Zhang, 2005; Keidel, 2009; Sicular, Ximing, Gustafsson, & Shi, 2007). Rural areas provide far worse health services and medical

infrastructure. In 2016, the neonatal, infant and under-five mortality rate for rural areas is 5.7‰, 9.0‰, and 12.4‰, much higher than those for rural areas 2.9‰, 4.2‰, and 5.2‰ respectively.

There is a long history in China of preferential policies toward urban residents in terms of employment, housing, health insurance, pension support, and other public subsidies (Park, Shen, Strauss, & Zhao, 2012; Solinger, 1999). Besides, there are also considerable differences across demographic groups in terms of coverage by safety nets and risks of falling into poverty (Duclos, Araar, & Giles, 2010). Rural residents have a lower coverage rate of pension than urban residents. According to the 2005 1% population sample, 45.4% of the urban population rely on pension for support, while only 4.6% of the rural population report pension as the primary source of financial support (Giles, Wang, & Zhao, 2010). By 2014, only 31% of China's total workforce, urban and rural combined, was eligible for a public pension of any kind. About 50% urban workers are covered by the pension program (Coeurdacier, Guibaud, & Jin, 2014). However, of rural residents over 60, roughly 5% of men and less than 1% of women have pension support, based on 2005 Population Census (Giles, Wang, & Cai, 2011). Elderly rural residents are on average poorer than urban ones, with a poverty rate of 22.3% compared to 4.6% (Lu, 2013). As a result of all of these rural-urban differences, the sources and dynamics of old age support are likely to be very different among urban and rural residents (Park et al., 2012).

Consequently, China's central government faces a greater than usual challenge in caring for the needs of the aging population in rural areas.

China's New Rural Pension Scheme (NRPS)

In September 2009, the State Council initiated NRPS to build the social safety net for rural residents. NRPS was designed to provide universal coverage of income security to rural residents when they reached 60 years old. NRPS was implemented in 320 pilot counties (10%

nationwide) in 2009, and expanded to cover all rural counties by 2012, according to the Ministry of Human Resources and Social Security (Bai, 2012).

The NRPS principles include guaranteeing basic benefits, aiming for universal coverage, applying flexibility at the local level, and ensuring sustainability as a policy initiative. The responsibilities to fund NRPS are split into individuals, institutions, and the government. Individuals should contribute to NRPS monthly in order to receive pension after 60 years old. Institutions include local governments at the community level, other nonprofit organizations and individual donors that care about the elderly's well-being and offer to donate in NRPS. The central government will subsidize local governments. In particular, using the basic standard of pension as a threshold, the central government will subsidize full amount to central and western regions, while only 50% to eastern regions, where local economy is much more developed. Therefore, NRPS can be considered as a hybrid of pay-as-you-go and pre-funded mechanisms. On one hand, individuals enrolled in NRPS pay their own contributions monthly. The more individuals contribute, the more amount of pension they will receive from NRPS. On the other hand, the central government will subsidize NRPS and institutions are encouraged to donate. Although the central government provides universal coverage of NRPS, and encourages rural residents to enroll, individual enrollment is completely voluntary.

For NRPS, enrollment is available to rural residents[1] who are aged 16 and over, not in formal education, and not enrolled in the urban or employment pension scheme. Enrollees should contribute annually in order to receive pension after 60 years old. Pensions are paid to enrollees who are rural residents, aged 60 and over. When NRPS was first implemented, rural residents

[1] Residents are defined by household registration (*hukou*) rather than residence. Only individuals with household registration in rural communities are eligible for NRPS. Urban and rural is also defined based on household registration.

who were aged 60 and over and not enrolled in urban employment pension scheme, were immediately eligible to receive pension, even though they were not prior enrollees in and never contributed to NRPS. However, any of their eligible children were required to enroll in NRPS. This family-binding eligibility mandate aims to accumulate enough funding to provide future pension for the growing aging population (State Council PRC, 2009).

Significance

The prevalence and consequences of obesity demand particular attention. Obesity represents a rapidly growing threat to the health of populations in an increasing number of countries. Indeed, obesity is now so common that it is replacing more traditional problems such as under nutrition and infectious diseases as the most significant causes of ill health.[2] Obesity is associated with the incidence of multiple comorbidities including type II diabetes, cancer and cardio-vascular diseases (Guh, Zhang, & Bansback, 2009). The worldwide prevalence has more than doubled since 1980. A number of studies have reported that with each surge in weight, there is an increase in the risks for coronary heart disease, type 2 diabetes, cancers (endometrial, breast and colon), hypertension, dyslipidemia, stroke, sleep apnea, respiratory problems, osteoarthritis and gynecological problems (Centers for Disease Control and Prevention, 2017). The trend in the rising prevalence of obesity and related morbidity and mortality in developing countries has been attributed to rapid urbanization, nutrition transition and reduced physical activity (Misra & Khurma, 2008). According to the Global Adult Tobacco Survey (GATS), China is the largest manufacturer and consumer of tobacco in the world, with about 301 million (28.1% of adults)

[2] Studies suggest that changes in mean or median BMI over time do not reflect changes in the distribution of BMI. The divergence indicates increased weight gain at high percentiles of the BMI distribution while little change at low percentiles in US, England, South Korea, Indonesia and many low- and middle-income countries (Green, Subramanian, & Razak, 2016; Kim, Subramanian, Oh, & Razak, 2018; Krishna, Razak, Lebel, Smith, & Subramanian, 2015; Razak, Corsi, & Subramanian, 2013; Vaezghasemia, Razak, Nga, & Subramanian, 2016).

smokers in 2010. There is large gender difference in smoking behaviors, among which 52.9% of men and 2.4% of women are smokers. The prevalence of smoking for men smokers is significantly higher for rural residents (56.1%) than urban residents (49.2%) (Li, Hsia, & Yang, 2011; Ng et al., 2014; J. Zhang, Ou, & Bai, 2011). The production and consumption of alcohol beverages across all types have increased steadily in China. According to the national representative sample, China Chronic Disease and Risk Factor Surveillance, 35.7% of adults are current drinkers. The prevalence of drinking among men (55.6%) are significantly higher among women (15.0%) (Y. Li et al., 2011; Tang et al., 2013) China has had a history of under-nutrition followed by the most rapid increase in obesity and related diseases worldwide, with differential rates across rural and urban areas (Van de Poel, O'Donnell, & Van Doorslaer, 2007).

Research Questions

The study proposes to examine the effect of China's NRPS on the elderly's BMI. In particular, the study considers pension from NRPS as a source of unearned income offered to the elderly and investigates how the elderly decide to distribute this additional income, for instance, to increase food expenditure and result in better health outcome as measured by BMI.

Previous longitudinal studies find an inverted U-shaped relationship between total household income and BMI. This study will improve by first testing whether pension from NRPS as a positive shock to total household income will affect BMI in a similar way. If so, the study will further explore potential pathways of this effect. Researchers have found associations between BMI and household food consumption, smoking and drinking behaviors and depressive symptoms, although results are mixed with respect to both the direction and the magnitude of these associations on different populations. This study will test whether these variables mediate the effect of pension from NRPS on the elderly's BMI.

Literature Review

Many countries have endeavored to provide income security to their aging residents, especially in the form of providing universal coverage of public pension. Research found effects of pension programs on health outcomes in several countries. Taiwan Farmers' Pension Program increases household medical expense per capita and pensioners' utilization of health services (Fan & Liu, 2012). South Korean public pension program, however, does not increase the recipient households' total or food expenditures due to 'crowding out' effects of private transfers (Jung, Pirog, & Lee, 2015). South African public pension and non-pension income have the same effect on food expenditures, and the elderly have no different food preferences from other adults (Case & Deaton, 1998); protects the self-reported health status of all members in a household that pool income, through mechanisms of ADLs, enhanced household sanitation, improved food security, and reduced psychosocial stress (Case, 2004); improves children's health and nutrition especially for girls and female pensioners (Duflo, 2000, 2003).

Many reports present descriptive results globally. Social pension programs have been validated to improving food security and promoting nutritional outcomes through access to food markets among poor households especially those in African countries (Adato & Bassett, 2008; DFID, 2011; OECD, 2009). Bangladeshi social pension impacts expenditure patterns that nearly all pensioners use the money to meet daily consumption needs, and report improvement in food security (Mannan, 2010); beneficiary households report a higher proportion of improved body-weight indicators, and consume more protein and fewer carbohydrates than non-beneficiary households (RED & BRAC, 2007). The majority of beneficiaries spend a significant share of social pensions on food in Thailand (Suwanrada & Wesumperuma, 2012), Nepal (Uprety, 2010),

and India (Government of India, 2009). In Vietnam, the social pension increases the quantity and diversity of food consumption (Long & Wesumperuma, 2012).

More studies on the cycle of purchases and consumption around monthly program receipt indicates short-term income effects on the quantity of food purchased and calories consumed among low-income households, i.e. food stamps and social security (Shapiro, 2005).

Besides being government programs, public pension programs also transfer cash to enrollees. However, research exploring the effect of this increased unearned income on obesity has mixed results. Income could lead to weight gain if food and sedentary pursuits are normal goods. However, good health and appearance could also be normal goods, leading one to invest more time and money in fitness as income rises. The impact of income on weight may follow an inverted U-shape; the first few thousand dollars may be spent heavily on food and thus may increase weight, but at some point the marginal utility of food may decline to the point that additional income results in little increase in calorie consumption; instead, the additional income may be invested in weight loss for the sake of appearance and health (Lakdawalla, Philipson, & Bhattacharya, 2005; Philipson & Posner, 2003).

Several studies found positive income shocks tend to have small effects on weight for women only (Schmeiser, 2009), no effect for the elderly (Cawley, Moran, & Simon, 2010), and the non-linearity income effect on weight (Akee, Simeonova, Copeland, Angold, & Costello, 2013). Weight may be especially responsive to income among low-income individuals in developing countries (Fernald, Gertler, & Hou, 2008; Fernald, Gertler, & Neufeld, 2008). However, evidence based on natural experiments implies that the impact of income on food expenditures in developed countries is very small (Kuhn, Kooreman, Soetevent, & Kapteyn, 2011; Parker, Souleles, Johnson, & McClelland, 2008).

However, little research has examined the connection between public pension programs and BMI either as a measure of obesity or a proxy for health status. The rise in obesity worldwide has serious implications for public health. Excess fat is harmful because it relates to several diseases, e.g. diabetes (Trayhurn & Beattie, 2001), various forms of cancer, and heart disease (Calle & Kaaks, 2004). The health consequence of morbid obesity (BMI $\geqslant$ 35) is a substantially higher risk of mortality (Flegal, Kit, Orpana, & Braubard, 2013). In addition, BMI ranges other than morbid obesity are harmful for health. All-cause mortality is minimal at BMI 20-25, while increases significantly both below this range and throughout the overweight range (The Global BMI Mortality Collaboration, 2016). Thus, being overweight and obesity, as well as underweight, poses risks to health.

Potential mediators, i.e. drinking, smoking behaviors, and depressive symptoms, have been examined by previous research. Research has shown that current smokers have a lower mean body mass index (BMI) than never and former smokers, with former smokers having the highest mean BMI (Albanes, Jones, Micozzi, & Mattson, 1987; Eisenberg & Quinn, 2006; Flegal, Troiano, Pamuk, Kuczmarski, & Campbell, 1995; Klesges, Meyers, Klesges, & La Vasque, 1989; Plurphanswat & Rodu, 2014; Prospective Studies Collaboration, 2009). An U-shaped relationship between depressive symptoms and BMI suggests that as BMI increases from underweight to overweight then obese, mean scores of depressive symptoms will first decrease then increase (Carpenter, Hasin, Allison, & Faith, 2000; De Wit, van Straten, van Herten, Penninx, & Cuijpers, 2009; Johnston, Johnson, Mcleod, & Jonhston, 2004). Drinking behaviors are found to associate with BMI, yet results are mixed (Breslow & Smothers, 2005; French, Norton, Fang, & Maclean, 2010; Istvan, Murray, & Voelker, 1995; Nies, Sun, Kazemi, Carriker, & Dmochowski, 2012).

Studies have found that NRPS has positive effects on several health-related measures, i.e. depression, ADL and IADL functional status cognition, care provided when sick, mental support, nutrition intake of fruits and vegetables (Y. Zhang, Cheng, & Liu, 2016; Zheng & Fang, 2015).

Theoretical Framework

The research aim is based on the theoretical framework of income and weight. In this case, pension from NRPS is considered as an increase in income, and BMI as a measure of height-adjusted weight. According to the hypothesis explaining the worldwide long-run rise in obesity, as income increases from a lower level, weights will initially rise, but at a higher level of income, further increases will indeed lower weights. Therefore, income and weight has an inverted U-shaped relationship (Lakdawalla & Philipson, 2009; Lakdawalla et al., 2005; Philipson & Posner, 2003).

According to this hypothesis, the non-monotonic income effect on weight is due to the same effect of weight on the individual's utility. Based on fundamental economic assumptions, an individual is rational in the sense that he/she makes decisions in order to ensure maximized utility. In this case, the individual's utility is dependent upon weight, food consumption, calories expended in physical activity or strenuousness of work and leisure, and other consumption. Another important assumption is an ideal weight. The individual prefers to gain weight when below the ideal weight, and prefers to lose weight when above the ideal weight. Note here the ideal weight is subjective, considering factors including health and beauty. Concerning closeness to the ideal weight, the more underweight the individual is, the more valued is weight gain. On the other hand, the more overweight the individual is, the less valued is weight gain. Thus, the individual's utility function has an inverted U-shaped relationship with respect to weight.

This inverted U-shaped relationship implies the similar effects of income on weight as well. In particular, the source of income should be unearned income, which does not request physical activity of work. Because working will involve physical activity as well as affect income, the effect of earned income on weight should also incorporate the effect of strenuousness of work.

In the utility function, food consumption and closeness to ideal weight are complements, otherwise income increases must raise food consumption thus weight. An increase in income affects the marginal value of weight, dependent on whether the individual is underweight or overweight. For the underweight, an increase in income raises the individual's marginal utility of gaining weight, because the individual is closer to ideal weight. Their demands for food and for ideal weight are in the same direction, suggesting increases in weight. For the overweight, however, an increase in income lowers the individual's marginal utility of gaining weight. Their demands for food are offset by demands for ideal weight, thus they will limit their calorie intake thus food consumption.

The inverted U-shaped relationship between unearned income and weight will be true only when the effect of consumption on marginal disutility of weight gains is higher for individuals with higher incomes, that is, the health shadow price of more food consumption increases with income. Individuals with higher income care more about their weight than individuals with lower income. Intuitively, when food prices are affordable, individuals prefer to consume as many calories, but to the extent of being overweight, where they care about their health and beauty. Wealthier individuals care more about their health and caution against being overweight, thus limit their calorie consumption thus weight more.

Method

Data[3]

The dataset is China Health and Retirement Longitudinal Study (CHARLS), modeled upon the U.S. Health and Retirement Study (HRS). CHARLS collects a nationally representative sample of Chinese residents aged 45 and over, excluding institutionalized individuals and Tibet. CHARLS provides rich information on the elderly's physical and mental health, healthcare, income and wealth, expenditure, intergenerational transfers, work and retirement.

CHARLS national baseline wave was fielded in 2011 through 2012, including survey sample of 17,708 individuals from 28 provinces, 150 counties or districts, and 450 rural village or urban communities, of which 52.67% are in rural areas. The overall response rate is 80.5%. Respondents were followed up every two years. Three waves are available for analysis. For each wave, to replenish the sample, the survey team tried to reach non-response individuals from previous waves to make up a refresh sample. The attrition rate is 10.93% (1,935 individuals) between the first and second waves. Meanwhile, 2,834 individuals are added in the second wave.

According to the users' guide (Zhao et al., 2013), the sampling design is multi-stage cluster sampling, including four stages, i.e. county, rural village or urban community, household, and individual. In each stage, sample was selected in order to guarantee representativeness.

In consideration of potential errors associated with self-reported health status, each respondent was asked to complete a biomarker survey separately, including height, weight, waist circumference, blood pressure, etc. The completion rate of the biomarker survey is 78.9%, which compares well with that of HRS.

[3] Acknowledgement: This analysis uses data or information from the Harmonized CHARLS dataset and Codebook, Version B.4 as of February 2017 developed by the Gateway to Global Aging Data. The development of the Harmonized CHARLS was funded by the National Institute on Ageing (R01 AG030153, RC2 AG036619, R03 AG043052). For more information, please refer to www.g2aging.org.

Research Design

In this study, treatment is defined as receiving pension from NRPS. The study will exclude the urban sample and rural residents covered by employment pension programs who are not eligible to NRPS.

The study will yield Local Average Treatment Effect (LATE) estimates incorporating fixed effects and instrumental variable.

This model compares individuals who report receiving pension from NRPS (treatment) versus individuals who report not (control). In particular, the control group includes individuals who are eligible to receive pension but do not enroll in NRPS, i.e. individuals aged 60 or over, and who are not eligible to receive pension from NRPS, i.e. individuals aged under 60 in NRPS-implementing communities and individuals residing in communities where NRPS is not implemented. Since the design is fixed effects model, individuals may serve as their own controls. For instance, a person residing in NRPS-implementing communities, who aged 58 in the first wave survey, is not eligible to receive pension. This person turns 60 in the second wave survey and becomes eligible for NRPS pension. If this person reports receiving pension in the second wave, the first wave observation of this person will serve as his own control.[4] Similarly, a person residing in communities where NRPS is not implemented in the first wave survey[5], regardless of age, is not eligible to receive pension. In the second wave survey, this person becomes eligible to receive pension if NRPS is rolled out in this community of his residence. If

[4] A sensitivity analysis will be conducted to omit people under 60 and to compare results.

[5] By the first survey wave fielded from mid 2011 through mid 2012, some rural communities had not adopted NRPS. By the second survey wave fielded in 2013 and 2014 and the third data wave in 2015 and 2016, all rural communities should have adopted NRPS.

this person reports receiving pension in the second wave, his observation in the first wave will serve as his own control.

Furthermore, the study will utilize the panel structure of the data and employ a fixed effects model to control for time-invariant confounding effects. The fixed effects include three types. 1) The primary fixed effects are the individual fixed effects, which control for time-invariant individual-specific characteristics. 2) Month fixed effects control for time-specific effects. Each wave of CHARLS was fielded for several months. The first wave was fielded for ten months from June, 2011 to March, 2012, the second wave lasts five months mostly from July to November, 2013 (only three observations were surveyed in December, 2013 and January, 2014), and the third last only two months mostly in July and August, 2015 (only 62 observations were surveyed in September, 2015 and January, 2016). The actual month of interview may affect individual outcomes, e.g. seasonal change of BMI outcome and increase in intergenerational transfers during New Year holidays. 3) Community fixed effects account for time-invariant community-specific characteristics. NRPS is an unconditional cash transfer program towards the rural elderly rather than a mean-tested public program. The exact amount of pension that enrollees will receive depends on their past contribution and on community of residence; but the treatment group here, the first group of individuals receiving NRPS pension did not make contributions. Thus, the community fixed effects are included to control for the regional differences in pension amount. However, the community fixed effects are controlled for in the individual fixed effects unless for individuals who move during the three survey waves, thus this is called the "mover" fixed effects. This mover fixed effects will be included in the model as a sensitivity analysis to see if the results change, in case that the individuals move to NRPS-

implementing communities to take advantage of the pension benefits, which poses selection bias over analysis results.

However, while the fixed effects design controls for time-invariant characteristics only, self-selection and endogenous bias may stem from unobserved time-varying confounding effects. Since enrollment in NRPS is completely voluntary, individuals who reside in counties where NRPS is implemented may choose to enroll or not, thus individuals who do enroll may not be representative of all eligible individuals. Using individuals' enrollment decision as the key variable, i.e. observed treatment in TOT, could lead to significant selection bias. For instance, if only individuals with worse health status will enroll in NRPS, and worse health status is also associated with receiving larger amounts of private transfers, this will underestimate the change in intergenerational transfers while overestimate the health enhancement effect of NRPS.

Moreover, confounding effects in dynamic terms are not controlled in the fixed effects. The fixed effects control for average individual-specific health status, but not for individual-specific health trajectories. To be specific, the fixed effects only control for changes in health trajectories common to treatment and control groups, but not for differences in trajectories. The differences in health trajectories may stem from biased selection into treatment, and result in biased estimation of results. In other words, treatment and control groups may have different health trajectories even with the absence of treatment, which are attributed to other characteristics than treatment. If these characteristics are mistaken as treatment effects, the estimated causal effects are biased.

Therefore, the study will further conduct local average treatment effect (LATE) analysis for a more accurate result and as a comparison of TOT estimates. The sample includes individuals within 10-year age range around the cutoff 60. The instrumental variable is whether

the individual aged 60 or over, which is the eligibility to receive NRPS pension. This instrument corrects for selection into treatment, and compares individuals who are just above and below the cutoff. LATE is the effect of treatment on the population of compliers, in this context, which are individuals who would enroll and receive pension when offered NRPS in community of residence and eligible to receive pension as well as who would not receive pension when not offered or not eligible. According to different status of assignment and treatment, eligible individuals are categorized into four groups [see Table 2]. Compliers are those who comply with the randomly assigned treatment or control status. Never-takers are those who don't take the treatment even when randomly assigned into the treatment group. Always-takers are those who manage to take the treatment even when put into the control group. Defiers are those who never comply to the assigned status, i.e. who do not take the treatment when put into the treatment group and who take the treatment when assigned to the control group (Angrist & Pischke, 2009, p. 112; 133). However, in this study, individuals are unlikely to receive pension unless NRPS is offered in community of residence, thus always-takers and defiers in the assigned control group are less likely.

For LATE analysis, the study will take advantage of the eligibility of receiving pension from NRPS and use an instrumental variable design. Following previous research (C. Zhang & Chen, 2014), the study will use age eligibility as the instrumental variable i.e. whether the individual is aged 60 and over. The endogenous variable is whether the individual receives pension from NRPS. Whether the individual is above 60 years old correlates with whether the individual receives pension from NRPS, which satisfies the identifying assumption.[6] In addition,

[6] In this study, being under 60 guarantees this individual cannot receive NRPS pension, which perfectly correlates with non-enrollment on the other hand. Thus, the first stage of 2SLS may have no effect on those under 60 because no distinction exists.

whether the individual is above 60 years old cannot be controlled by individuals, i.e. is exogenous to individuals, which satisfies the exclusion restriction. Thus, this variable should be a valid instrument for the endogenous variable whether the individual actually receives pension from NRPS.

Analytical Plan

First, the fixed effects include individual and month. In the fixed effects model, however, time-invariant variables, e.g. gender, education, number of children, will drop out. Education and the number of children are unlikely to change over time because the main respondents are aged 45 and over. These variables are collinear with each individual's fixed effect, and their impact has been captured by the individual fixed effects already. Moreover, the variables that change at the same rate for all individuals, i.e. age, will drop out as well. The model includes a time variable, which captures differences in interview month that may affect outcomes.

Second, an instrumental variable design will be used to estimate the LATE for this same outcome variable, through 2-Stage Least Squares (2SLS) (Angrist & Pischke, 2009). According to the age eligibility to receive pension from NRPS, only individuals over 60 years old can receive pension, so the treatment variable $NRPSIND_i$ is a discontinuous function of age age_i.

$$NRPSIND_i = \begin{cases} 0, & age_i < 60 \\ 1, & age_i \geq 60 \end{cases}$$

where $NRPSIND_i$ is the treatment status variable, indicating whether individual i receives pension from NRPS; age_i is the age of individual i.

In this study, at the discontinuity of the age cutoff, the change may not be 0 to 1. For instance, the implementation of paying pension to eligible enrollees may take months. Rather,

the probability of $NRPSIND_i$ being 1 increased, so the relationship between $NRPSIND_i$ and age_i is as follows:

$$P[NRPSIND_i = 1|age_i] = \begin{cases} g_1(age_i) & age_i \geq 60 \\ g_0(age_i) & age_i < 60 \end{cases}, g_1(age_i) \neq g_0(age_i)$$

where the assumption is that $g_1(\text{age}_\text{i}) > g_0(\text{age}_\text{i})$, the probabilities of receiving pension for enrollees aged 60 and over are greater than that for enrollees under 60 years old.[7]

In 2SLS, the first stage regresses the endogenous explanatory variable, i.e. whether the individual receives pension from NRPS, on the instrumental variable, i.e. whether the individual aged 60 and over, and other exogenous variables. To accommodate the binary nature of the endogenous explanatory variable, the first stage will use a multivariate logistic regression model.

$$Logit(NRPSIND_{it}) = \pi_0 + \pi_1 AGE60_{it} + \pi_2 age_{it} + \pi_3 age_{it}^2 + \pi_4 AGE60_{it} * age_{it} + \pi_5 AGE60_{it} * age_{it}^2 + \pi_6 Z_{it} + \alpha_i + u_{it} \quad (1)$$

In this equation, for individual *i*, at interview month *t*, $NRPSIND_{it}$ is the expected value of the endogenous variable indicating whether the individual receives pension from NRPS. $AGE60_{it}$ is the instrumental variable, α_i is the time-invariant unobserved effect, and u_{it} is the idiosyncratic error, Z_{it} is a vector of exogenous covariates, including age, age-squared, gender, education, marital status, ADL/IADLs, work status, household size, number of children, household income, and non-coresident children's household income. The interaction terms of the instrument and the running variable (age) allow the relationship between the running variable and treatment to change below and above the cutoff (60 years old).

[7] In contrast, in a sharp regression discontinuity, the probability of receiving pension from NRPS is 1 if the individual is aged 60 and above, and the probability is 0 if the individual is under 60.

The second stage regresses the outcome variable on the fitted values of the endogenous variable generated from Equation 1, and other exogenous variables than the instrumental variable.

$$BMI_{it} = \beta_0 + \beta_1 \widehat{NRPSIND}_{it} + \beta_2 f(age_{it}) + \beta_3 Z_{it} + \alpha_i + \varepsilon_{it} \quad (2)$$

In this equation, $f(age_{it})$ is a polynomial function of age_{it}, allowing for non-linear relationship of age and intergenerational transfers, α_i is the time-invariant unobserved effect, and ε_{it} is individual random error. Z_i is a vector of covariates, including age, age-squared, gender, education, marital status, ADL/IADLs, work status, household size, number of children, pre-transfer household income, and non-coresident children's household income.

The study will test household food consumption, smoking, drinking behaviors and depressive symptoms as potential mediators. In mediation analysis, three requirements must be met to define a true mediation relationship (Baron & Kenny, 1986). First, the independent variable must be a significant predictor of the dependent variable. If the third research question does find that receiving pension from NRPS affects the elderly's BMI, this satisfies the first requirement. Second, the independent variable should also be a significant predictor of the mediator. This will examine whether receiving pension from NRPS affects the elderly's household food consumption, smoking, drinking behaviors and depressive symptoms independently.

Measures

The outcome variables include the amount of monetary and time transfers the elderly received from non-coresident adult children in the past year, the elderly's BMI, drinking and smoking behaviors. In CHARLS, respondents are asked separately about the amount of monetary

transfers and in-kind support they received. This study will combine these two kinds of transfers in analysis.

The mediators include household food consumption, smoking, drinking frequencies and depressive symptoms. The household food consumption indicates the family expenditure on food last week, excluding expenditures on eating out, cigarettes or alcohol. Smoking behavior is measured as the frequencies of smoking last month. Drinking behavior is measured as the frequencies of drinking last year. Depression measure is the instrument initially developed the Centre for Epidemiological Studies Depression Scale (CES-D). CES-D is a 20-item screening tool detecting depression in general populations (Radloff, 1977). CHARLS dataset uses CES-D-10, which is a shorter version consisting of 10 items, and validated for the elder population (Andresen, Malmgren, Carter, & Patrick, 1994).

The parents' demographic variables are age, age-squared, gender, education, marital status, ADL factors, and household size. Age-squared will allow for a non-linear relationship between age and outcomes. Gender will be included as a covariate, and as a stratifier to split sample for separate analysis. Female pensioners and male pensioners pool pension income differently within households (Bertrand, Mulainathan, & Miller, 2003; Case & Deaton, 1998; de Carvalho Filho, 2012; Duflo, 2003; Ponczek, 2010; Posel, Fairburn, & Lund, 2006; Thomas, Schoeni, & Strauss, 1996).

Education is a measure of the highest educational attainment. Since the sample only includes rural residents, they tend to have lower education levels than urban residents. The variable is recoded based on the baseline codebook, i.e. no schooling (32.8%), some or finished primary schooling (42%), finished junior high school (19.2%), and finished high school and above (6%). Previous studies (Jiao, 2016; Lei et al., 2012; C. Zhang & Chen, 2014) have

included education level as several dichotomous variables. This study, however, will include one categorical variable instead, in order to control for the inflated standard error with multiple dummy variables. Marital status is a measure indicating whether the respondent has informal support from his/her spouse.

ADLs (Activities of Daily Living) are self-care tasks necessary for every day, measuring the elderly's functional status. For the older population especially, ADL serves as a proxy for health status. Previous research (Lei et al., 2012; C. Zhang & Chen, 2014) using CHARLS have constructed ADL as having difficulty with at least one ADL. However, this dichotomous measure fails to account for severity. This study uses the ADL index according to the harmonized CHARLS dataset by RAND. The ADL summary is created based on Wallace and Herzog (1995), which summarize activities of bathing, dressing and eating. Classic ADL indexes, i.e. the Katz Index of Independence in ADL (Katz, Down, Cash, & Grotz, 1970) and the Bristol ADL Scale (Bucks, Ashworth, Wilcock, & Siegfried, 1996) will be referenced.

Moreover, a time variable of interview month is included to control for the time effect in addition to the individual fixed effects model. Rather than control for the interview wave, this study controls for interview month, which examines the time effect more accurately.

Preliminary Results

Table 1 Descriptive statistics

	Wave 1	**(2011)**	**Wave 2**	**(2013)**	**Wave 3**	**(2015)**
Treatment	Control	Treatment	Control	Treatment	Control	Treatment
Receiving NRPS (No /Yes)	8,400	1,054	5,209	4,064	4,821	4,614
	Mean *Std. Dev.*	Mean *Std. Dev.*	Mean *Std. Dev.*	Mean *Std. Dev.*	Mean *Std. Dev.*	Mean *Std. Dev.*
Outcomes						
Household income	11454.90	9715.37	*12645.38*	7891.84	9226.06	8336.32

	32643.28	*14942.45*	*30047.78*	*15712.42*	*28243.47*	*73616.81*
BMI	22.91	22.85	23.54	22.85	23.43	23.14
	3.92	*3.56*	*3.78*	*3.77*	*3.89*	*4.04*
Food consumption	106.94	103.54	*213.10*	*160.43*	213.32	174.22
	133.39	*160.19*	*568.32*	*204.69*	*351.85*	*261.78*
Drinking frequency	1.03	0.95	*1.33*	*1.26*	1.25	1.26
	2.25	*2.20*	*2.50*	*2.49*	*2.40*	*2.44*
Smoking frequency	4.20	3.84	*3.07*	*2.30*	4.97	4.15
	9.44	*8.86*	*8.05*	*6.75*	*10.13*	*8.77*
Depression	9.49	9.28	*8.46*	*8.76*	8.87	9.04
	6.56	*6.48*	*5.96*	*6.11*	*6.65*	*6.69*
Covariates						
Age	61.85	68.14	*60.75*	*68.49*	63.14	68.13
	8.35	*6.87*	*7.47*	*6.91*	*8.13*	*7.08*
Gender	0.52	0.54	*0.53*	*0.53*	0.54	0.53
	0.50	*0.50*	*0.50*	*0.50*	*0.50*	*0.50*
ADL-6	0.50	0.50	*0.39*	*0.60*	0.56	0.66
	1.17	*1.21*	*0.99*	*1.24*	*1.22*	*1.29*
Household size	3.68	3.56	3.81	3.55	3.00	2.84
	1.97	*1.95*	*1.99*	*1.99*	*1.40*	*1.36*
Whether co-reside with children	0.56	0.50	0.51	0.45	0.54	0.51
	0.50	*0.50*	*0.50*	*0.50*	*0.50*	*0.50*
Marital status						
Married	77.76	73.34	81.28	73.62	77.49	74.21
Partnered	6.60	4.27	5.74	3.13	5.81	3.60
Separated	0.56	0.28	0.29	0.32	0.17	0.22
Divorced	0.45	0.38	0.48	0.27	0.48	0.30
Widowed	13.51	20.59	11.21	21.51	14.98	20.74
Never Married	1.12	1.14	1.00	1.16	1.08	0.93
Education						
Illiterate	39.12	44.69	35.64	44.96	37.13	41.48
Did not finish primary school	22.03	24.19	22.14	22.88	21.30	22.40
Elementary school	20.98	21.73	19.80	22.47	19.88	23.87
Middle school	13.14	8.44	15.59	8.32	15.11	9.93
High school	4.73	0.95	6.84	1.38	6.58	2.32

Table 2 The Effect of Receiving NRPS on BMI (Individual and Wave Fixed Effects)

	(13.1) BMI	(13.2) Underweight	(13.3) Overweight US	(13.4) Overweight Asia	(13.5) Overweight China
Receiving NRPS	0.003	-0.005	0.000	-0.004	-0.001

	(0.045)	(0.004)	(0.005)	(0.006)	(0.006)
N	20240	20240	20240	20240	20240
R^2	0.8740	0.7688	0.8393	0.8397	0.8372
adj. R^2	0.7939	0.6218	0.7371	0.7378	0.7337

Note: All models control for age, age-squared and age-cubed. Standard errors in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3 The Differential Effect of Receiving NRPS on BMI (IV + Fixed Effects)

	(14.1) BMI	(14.2) Underweight	(14.3) Overweight US	(14.4) Overweight Asia	(14.5) Overweight China
Receiving NRPS	0.514*	-0.079	0.011	0.086	-0.090
	(0.235)	(0.050)	(0.074)	(0.078)	(0.078)
Age	0.898*	-5.040*	-1.925	3.328	-4.677
Age-squared	-0.007*	0.083*	0.032	-0.054	0.078
Age-cubed		-0.000*	-0.000	0.000	-0.000
N	9755	9755	9755	9755	9755
R^2	0.8852	0.7406	0.8500	0.8460	0.8472
adj. R^2	0.8034	0.5559	0.7431	0.7363	0.7383

Note: Standard errors in parentheses. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4 The Effect of Receiving NRPS on Mediators (Individual and Wave Fixed Effects)

	(17.1) Smoking frequency	(17.2) Drinking frequency	(17.3) Depression	(17.4) Food consumption	(17.5) Log food consumption
Receiving NRPS	-0.055	0.070**	-0.333***	-23.251***	0.003
	(0.079)	(0.026)	(0.097)	(6.726)	(0.027)
N	22512	26168	24289	20760	20760
R^2	0.8809	0.8233	0.6776	0.4383	0.5569
adj. R^2	0.8067	0.7213	0.4899	0.0734	0.2691

Note: All models control for age, age-squared and age-cubed. Standard errors in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5 The Effect of Receiving NRPS on Mediators (IV + Fixed Effects)

	(18.1) Smoking frequency	() Smoking frequency	(18.2) Drinking frequency	(18.3) Depression	(18.4) Food consumption	(18.5) Log food consumption
Receiving NRPS	-0.844^{+}	-0.965	0.231	-0.105	87.276	0.531
	(0.486)	(1.071)	(0.346)	(1.258)	(91.840)	(0.366)
N	10799	10799	12855	12193	10419	10419
R^2	0.8893	0.8891	0.8427	0.7086	0.4716	0.5524
adj. R^2	0.8122	0.8119	0.7383	0.5143	0.0949	0.2332

Note: All models control for age, age-squared and age-cubed. Standard errors in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Limitation

The study suffers from several limitations. The first concern is that LATE estimates may be subject to heterogeneity of treatment effect. Individuals within the sample are heterogeneous and these varying characteristics can potentially modify the treatment effect. On the other hand, LATE estimates assume a similar treatment effect across heterogeneous individuals, and yield an average treatment effect, which may vary considerably from the treatment effect of subgroups. If the subgroup having larger treatment effect are also more likely to take up the treatment, the LATE estimates are upward biased. This treatment effect heterogeneity may arise from an underlying causal mechanism or selection bias. Heterogeneity of treatment effect is the nonrandom, explainable variability in the direction and magnitude of treatment effects for individuals within a population.

The second major threat to internal validity is selection bias. For rural residents in the counties where NRPS is implemented, their individual selection bias in participating in NRPS is controlled by the instrumental variable design. However, the NRPS expansion on the county level may not be random by design, rather the central government selects pilot counties based on some unknown threshold. For instance, if NRPS expansion is need-based, pilot counties may disproportionally have higher poverty rates, thus showing stronger 'crowding out' effect. In this case, the threat of regression to the mean is added upon selection bias. Thus, this may overestimate the true treatment effect of receiving pension from NRPS by disproportionally including more poor population rather than random assignment. The study will check the robustness of NRPS expansion, comparing measures of economic development and demographic characteristics of communities that adopted NRPS against communities that did not in 2011.

Third, attrition can be another threat to internal validity. Between the first two waves, 2,526 individuals (14.27% of the sample) dropped out of the survey. Among them, 431 individuals are included in the CHARLS exit survey and documented as mortality. If these dropouts are not complete at random, which is most likely the case, the attrition would produce bias on results. The fixed effects control for any time-invariant factors that are related to survey attrition or mortality. The study will further check the robustness, comparing demographic measures of individuals who remained in CHARLS versus those who dropped out of the survey.

Finally, BMI as a measure of fatness may not be accurate. BMI does not measure fatness, merely weight for height, so individuals with above-average lean mass (e.g. muscular individuals) may be incorrectly classified as obese (Burkhauser & Cawley, 2009). However, CHARLS does not provide more detailed measures regarding obesity than BMI.

The study is the first to examine the relationship between receiving pension as an unearned income from NRPS and the rural elderly's BMI, and aims to provide the optimum range of pension income regarding the BMI outcome for further policy improvement. The study will contribute to obesity literature as well as government programs literature, by investigating whether a government program not directly targeting towards obesity will have effect on BMI through providing unconditional income transfers.

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