China Economic Review 41 (2016) 315–330

Contents lists available at ScienceDirect

China Economic Review

Does New Rural Pension Scheme decrease elderly labor supply? Evidence from CHARLS

Manxiu Ning [a], Jinquan Gong [b], Xuhui Zheng [c], Jun Zhuang [d,*]

[a] College of Economics, Fujian Agriculture and Forestry University, China
[b] Department of Economics, University at Buffalo, SUNY, USA
[c] School of Economics and Management, Fuzhou University, China
[d] Department of Industrial and Systems Engineering, University at Buffalo, SUNY, 317 Bell Hall, Buffalo, NY 14260-2050, USA

ARTICLE INFO

Article history:
Received 27 January 2016
Received in revised form 26 April 2016
Accepted 27 April 2016
Available online 30 April 2016

JEL classification:
J14
I38

Keywords:
Labor supply
New Rural Pension Scheme
Regression discontinuity design
Difference in difference

ABSTRACT

This paper examines the effect of the New Rural Pension Scheme (NRPS) on the labor supply behavior of the elderly in rural China. Using pooled data from two waves of the China Health and Retirement Longitudinal Survey (CHARLS) and an analytical framework of combination of regression discontinuity design and difference in difference method (RD-DiD), we find no evidence that pension receipt from the NRPS program does significantly induce the elderly to withdraw from the labor market. The heterogeneous effects by health status indicate that pension recipient slightly decreases the probability of labor force participation for those individuals with chronic diseases; however, the effect is not statistically significant. The empirical findings suggest that the introduction of the NRPS program does not improve the welfare effect of the originally targeted elder individuals with illness.

1. Introduction

China, as a developing country, has been undergoing an unprecedented demographic transition and rapid population aging in pace with the decline infertility rates and rising life expectancy. According to the Sixth National Population Census of China, the percentage of population aged 60+ increased from 10.33% in 2000 to 13.26% in 2010 (National Bureau of Statistics, 2011), the trend is projected to rise to 32.8% in 2050 (United Nations, 2010).[1] Although the average income of Chinese households has risen dramatically since market-oriented economic reform and opening in 1978, the rural elderly have not benefited from such economic growth to the same extent as younger people and the urban cohort (Cai, Giles, O'Keefe, & Wang, 2012).It is extensively acknowledged that, traditional systems of family support have been collapsed due to decline of birth rate, shrinking of family size and massive labor rural–urban migration, and that furthermore, lack of established social security systems put the rural elderly at the risks of vulnerable economic conditions and poverty. How to establish social security policies aimed at improving the welfare of the elderly in rural China and preventing them from falling into poverty has been the central topic for policy makers.

Traditionally, in the absence of pensions support and savings, the elderly in rural China have to work throughout old age until they are no longer physically capable, which is described as a metaphor of "ceaseless toil" (Benjamin, Brandt, & Fan, 2003; Pang, de Brauw, & Rozelle, 2004). It is clear that the elderly well-being (e.g., health),in particular of those engaged in physically strenuous

* Corresponding author.
E-mail address: jzhuang@buffalo.edu (J. Zhuang).

[1] By international standards, aging society is defined as its population with aged 60 and 65 or over exceed 10% and 7% respectively.

http://dx.doi.org/10.1016/j.chieco.2016.04.006
1043-951X/

jobs, would be sacrificed at the cost of mitigation of their adult children's economic supporting burden through the elderly own labor income. One major reason for the decline of well-being for the elderly is that they are obliged to work even in poor health. A recent study conducted by Li, Lei, and Zhao (2014) uses four waves of CHNS data and hypertension as the measure variable of health to investigate the impact of health on labor supply of Chinese elderly, where the results indicate that hypertension has significantly negative effects on urban elderly but no effect on rural elderly. One explanation is that considerable urban–rural differences exist in the level of coverage by safety nets and the benefits received through the social welfare system. Urban elderly better covered by social security systems have incentives to retire early, while for those exposed to the risks of economic vulnerability and poverty in rural China, a severe shortage of institutionalized risk sharing mechanisms like public social security programs leave them little or no choice other than to continue their work intensity even with illnesses.

As one of the traditional scarce resources, time, like income, plays a non-negligible role in a person's wellbeing. A growing number of economists recognize that any inquiry in to the nature of well-being thus involves not only asking what income people do (or do not) possess but also how they conduct their lives and whether they have time-autonomy. The lengths of working hours, as well as the intensity of time use, convey information about quality of life (Floro, 1995). Further, Robeyns (2003) argues that long work time and heavy workload not only result in decrease of time to restore physical strength, and to improve physical health, mental wellbeing and the quality of life combined with leisure activities, but also lead to the loss of chance to participate in social activities. Several studies provide considerable evidence that poor social connections, infrequent participation in social activities, and social disengagement predict the risk of cognitive decline in elderly individuals (Zunzunegui, Alvarado, Del Ser, & Otero, 2003).Consequently, sufficient leisure time for the elderly to involve themselves in social activities can improve their mental health, life satisfaction and wellbeing.

In response to the rapidly aging population and improve the welfare of old-age people, the Chinese government launched an innovative program, the National Rural Pension Scheme (NRPS) for rural residents in late 2009 (the institutional design will be discussed in detail in Section 3), and expanded the NRPS program to cover full geographic areas in rural China by the end of 2012. In late 2009, the pilot program started in 10% of counties nationwide, approximately 103 million rural residents enrolled in NRPS in 2010, but the figure increased dramatically to 497million in 2013, including an increase of 28 million to 138 million elderly aged 60 + covered by NRPS.[2] The NRPS sponsored by the Chinese central government is regarded as a significant milestone for the fact that rural residents in China are forwarded into a new era of social pension systems, a departure from the traditional family support system. In this context, investigating how eligible individuals respond to such public program expansion is crucial to determine whether scarce fiscal resources with competitive objectives are efficiently allocated to the special demographic group originally targeted.

Theoretically, the design of a pension system and its reform must explicitly recognize that pension benefits are claims against future economic output. To fulfill this objective, Holzmann and Hinz (2005) indicate that pension program reforms should be designed and implemented to support growth and development and diminish possible distortions in labor markets. It is important to note, however, that the primary goal of a public pension scheme is to provide reasonable protection against the risks of economic and time poverty by efficiently allocating resources to the elderly (Holzmann & Hinz, 2005). As far as NRPS is concerned, despite any disincentive and behavior distortion of working-age adults in labor market under coverage of NRPS may not be the most policy makers would like to see, reduction of economic activities and even withdrawal from labor markets for those elderly with poor health and heavy work burden in rural China is the objective of social pension program to provide the elderly with adequate security.

To date, considerable attention has been paid to crowding out effect of NRPS on intergenerational economic transfer from adult children to the elder parents (Chen & Zeng, 2013; Cheng, Zhang, & Liu, 2013; Zhang & Chen, 2014), very little is known about the relationship between the elderly labor supply behavior and public pension scheme in rural China. To fill this knowledge gap, the primary objective of this paper is to explore the welfare effect of NRPS on the originally targeted elder individual's labor supply behavior by using the particularly detailed data on China's elderly population from the China Health and Retirement Longitudinal Survey (CHARLS). In particular, the paper tries to answer the following question: whether, and to what extent, does the enforcement of NRPS in China lead to change of labor market behavior of the elderly? Does NRPS reduce labor supply of the elderly with poor health compared to those in good health conditions? The empirical findings would have far-reaching implications for the efficacy of public transfer or redistributive programs such as NRPS, in the case of retirement for rural elderly, such programs may have positive welfare effects on the intended beneficiaries. Furthermore, an understanding of the inter-linkage between informal arrangements of elderly support and social redistributive program provides further insight into the design of social security systems targeted to the vulnerable group in developing countries.

This study contributes to the existing literature by evaluating the welfare effect of public pension program from alternative perspectives that have not been well explored in developing countries. Also, understanding the behavior response of the labor supply due to pension expansion in rural China is of particularly great importance for some less developed countries in Southeast Asia experiencing rapid demographic aging, as they have already taken actions to establish state-sponsored pension programs for the elderly.

The remainder of this paper proceeds as follows. Section 2 provides an overview of the literature. Section 3 describes an institutional background of NRPS in China. Section 4 illustrates the theoretical framework. Section 5 introduces the data set and the empirical model and estimation strategies are shown in Section 6. The empirical results are presented in Section 7 and conclusions are exhibited in Section 8.

[2] Data were obtained from Ministry of Human Resources and Social Security of China. http://www.mohrss.gov.cn/SYrlzyhshbzb/zwgk/szrs/.

2. Literature review

Since social security programs are introduced as an effective way to meet the aging population, the labor market distortions of working-age individuals have attracted increasing attention and concern from the policy makers and scholars. Previous studies (see Gustman & Steinmeier, 1986; Holzmann & Hinz, 2005) generally indicate that the public pension systems can distort the labor market through economic incentive for earlier retirement and reduced work hours because of highly implicit marginal tax rate on wages, and further lead to a lower economic output. As a consequence, this will ultimately exert negative effects on the financial sustainability of old age pension programs. Nevertheless, an important factor to understand when assessing the welfare effects of social security proposals is the elasticity of elderly labor supply (Vere, 2011).

For several decades, there have been rapidly growing interests in investigating the potential link between public pension programs and labor supply of the elderly in developed countries. For example, a large number of literatures focus on the impacts of different features of the social security program, like earning tests, on the labor participation and working hours of older workers in the U.S (Friedberg, 2000; Gruber & Orszag, 2003; Hofer & Koman, 2006; Hurd & Boskin, 1984; Ruhm, 1996; Vere, 2011). Evidence for other countries can be found in Baker and Benjamin (1999) for Canada, and Disney and Tanner (2000) for the UK. Virtually all of these studies document that social security programs create positive incentives for earlier retirement. Previous studies indicate that earlier retirement and lower labor force participation by the elderly in developed countries exacerbate public pension budgets (Bosworth & Burtless, 1998; Gruber & Wise, 2007; Kinsella & Velkoff, 2001), because wage earnings are an alternative source of income for the elderly that does not require public expenditures (Gruber & Wise, 1998; Lumsdaine & Wise, 1994).

However, using these findings from the industrialized world to make inferences about the design of public pension program for developing countries would likely be misleading. The reasons lie in the facts that: First, most developed countries, where a universal pension program has been in operation for several decades, are exploring the ways to reduce fiscal pressures of pension systems and cope with the negative shocks of low labor participation rate on the macroeconomics through an increase in retirement age and a reduction in pension benefit levels (Blau & Goodstein, 2010). On the contrary, the rural areas in developing countries including China are the other side of the story: how to maintain a basic livelihood and alleviate the risk of poverty for the rural elderly has become an important concern of policy makers. Second, it is widely acknowledged that the fundamental distinctions of the specific public pension programs between developed and developing countries come from different resource constraints, policy environments and institutional arrangements including the set of eligibility categories, benefit levels, and marginal tax rates assigned to the different demographic groups.

To our knowledge, sizeable research has been conducted on the effects of the social pension paid to elderly on the extended household's member in Africa (see, for example, Ardington, Case, & Hosegood, 2009; Bertrand, Mullainthan, & Miller, 2003; Case & Deaton, 1998; Duflo, 2003; Edmonds, 2006). However, these literatures usually ignore the sensitivity of the actual recipient's (namely, the elderly) retirement behavior with respect to increase in pension benefits.

In recent years, a few empirical literatures regarding the elderly labor supply response to pension receipt in developing countries mostly emerges from South Africa (Ranchhod, 2006), Brazil (de Carvalho Filho, 2008) and Mexico (Juarez, 2010), but the conclusions are ambiguous. For example, Ranchhod (2006) documents the effect of the means tested South African Old Age Pension on labor supply among the elderly, and finds significant decreases in employment rate and labor supply. Unlike means-tested schemes, de Carvalho Filho (2008) addresses the impact of increased pension benefits and reduced minimum eligibility age in rural elderly in Brazil, and shows that receiving old-age benefits increases the probability of retirement by 38% and reduces total hours per week by 22.5h. Similarly, Kaushal (2014) identifies that India's National Old Age Pension Scheme has a modestly negative effect on the employment of elderly men with lower education while no effect on the employment of similar women. Juarez (2010) finds that, on the other hand, generous old-age Demogrant, which is not means-tested in Mexico, has no significant effect on labor supply of the eligible elderly and nearly elderly, except for the sharp decrease in the employment of non-elderly adults living in a household with elderly members. These inconsistent findings across countries partially result from differences in institutional settings and programmatic details (Kaushal, 2014).

As discussed earlier, the potential linkage between social security and labor supply of the elderly in rural China has obvious significance for policy designs. Notwithstanding that, very few empirical studies have been carried out on this issue due to the lack of extensive coverage of public old age pension in rural China. Since the NRPS program has been introduced to cover the rural sector in 2009, China presents an interesting setting and a good “natural experiment” in which to investigate the essential effect of NRPS on labor market behavior of the rural elderly.

3. Institutional background of NRPS in China

Different from the elderly in urban China, the well-established public pension program for rural elderly consisting of a vast majority of China's population has been in a vacuum over the past decades. Due to lack of old age pension, own labor income and financial transfer from adult children are important sources for the rural elderly in China to maintain their livelihood in old age (Cai et al., 2012). According to the Sixth National Population Census of China, the labor participation rate of population aged 60 or over in rural China is highly up to 43% (National Bureau of Statistics, 2011), which indicates that near half of the rural elderly rely on their own labor income for a living.

Historically, the rural pension program (traditionally called “old rural pension”) has been experimented on and off to extend the rural sector in a few developed provinces of East China since the late 1980s, despite a breakdown of the old rural pension at sub national level due to lack of public financial support, these diverse experiences have provided important lessons for policy makers to

establish a national framework for rural pensions,namely, the New Rural Pension Scheme (NRPS) in China. The NRPS program, announced in 2009, is particularly unique in developing countries due to its policy arrangements illustrated below in detail.

First, it is voluntary to participate in NRPS for all rural residents aged 16 or over who are not students and are not already covered in a basic urban scheme. They can participate whether they work in a rural or urban area, whether they are self-employed or employed (Chen & Turner, 2014). In regard to contribution rates, the contributions to NRPS are not calculated on the basis of the individual's earnings, and anyone meeting the age requirement can contribute. Individuals' contributions range from 100 to 500 RMB Yuan (1 RMB Yuan is about 0.1607 USD) annually at their choice. At the same time, some provinces and counties have allowed for considerably higher contribution levels from farmers of up to 2,500Yuan in some coastal areas. Regardless of the contribution level chosen by the participant, local governments provide a partial matching contribution subsidy to the individual contribution with at least 30 Yuan per year. Participants must contribute for 15 years in order to vest and be eligible to receive pensions at 60 years of age. For participants who are older than 45 when joining the scheme, to qualify for benefits they will have to contribute every year up to age 60 and then make a lump-sum payment to cover the shortfall in years (Cai et al., 2012).

Second, with respect to benefits, the scheme provides for individual pension accounts with matching contributions and a basic flat pension for participants who have contributed for 15 years. The initial value of the basic pension under the scheme is 55 RMB per month, which is not means tested and is subsided by the central government in full for central and western regions and in half for eastern regions. Furthermore, the basic benefits can be topped up by local governments at their discretion from their own revenues. Individual account benefits are calculated on the base of accumulation in the participant's contributions from the individual's account and accrued investment returns, and paid monthly by dividing the accumulation at age 60 by 139.

Last but not least, one uniqueness for NRPS is that those who are currently 60 years old or over can receive the basic pension benefit at the time of introduction of the scheme, provided all their eligible children are contributing to the scheme (that is, "family binding").Although some critics argue that "family binding" provisions may lead to exclusion from NRPS for those poor elderly not able to satisfy such conditions, these create significantly positive incentives for those approaching retirement age and their children to participate in NRPS and to some degree avoid individual's adverse selection in the social insurance market. The eligibility rules for receiving old age pension are illustrated in Fig. 1. As shown in Fig. 1, all NRPS participants are eligible to receive monthly pension payments when they turn 60 (i.e., region A).

As noted, the general framework of the New Rural Pension Scheme in China reflects a number of lessons from international experience. For example, matching individual account contributions, or matching defined contributions (MDC), provides a strong incentive to attract participation of the rural population and those in the nonwage sector, which is also consistent with the experience in many OECD countries and in middle-income countries such as Brazil and Mexico (Dorfman et al., 2013). Besides, the introduction of a basic minimum benefit echoes the practice of many developed and developing countries that have introduced social pensions for the elderly (Cai et al., 2012; Dorfman et al., 2013). However, the linking of eligibility for the basic benefit to individual accounts contributions, in particular, "family binding" arrangement, represents an important difference in other developing and developed countries. In addition, eligibility for basic pension benefits under the NRPS program that is not subject to some form of means testing such as income or income plus assets indicates another significantly dissimilar feature for many OECD countries (e.g., the United State and Canada) and developing countries (e.g., South Africa, where the social pension is non-contributory and means tested on individual income).

Judging from the uniqueness of NRPS discussed above, China provides an interesting context for studying the labor market behavior of the elderly because of its experience with economic transition from planned economics to market economics, its dramatic growth in the elderly dependency ratio, and its distinctive pension program.

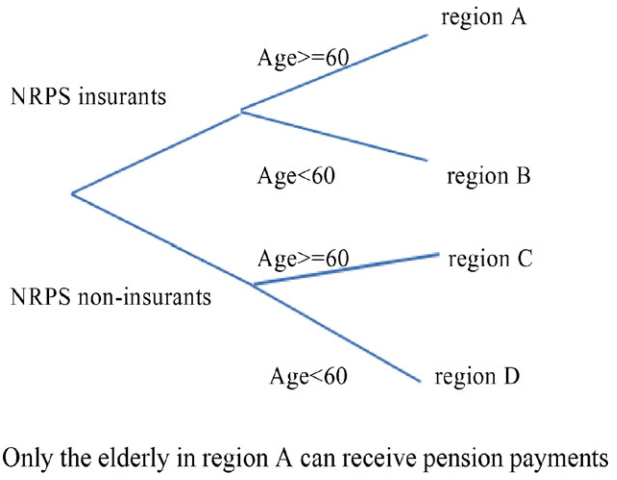


Fig. 1. Eligibility rule of NRPS program in China.

4. Theoretical framework

Theoretically, the social pension system is expected to exert influence on labor supply behavior and retirement decision of old workers through two major channels: income effect and substitution effect. On one hand, an increase in pension benefits will relax the elderly (in particular, those engaged in physically strenuous work) liquidity constraints, smooth consumption later in life, and make his/her retirement affordable (income effect). As a consequence, the elderly beneficiaries within the framework of a social pension scheme may prefer leisure to labor and thus reduce their labor supply and even totally withdraw from labor force market. On the other hand, implicit marginal taxes on continuing work in old age pension systems imposed by contributory pension arrangements and/or the social security earnings test,[3] tend to deter workers from remaining in the labor market ("substitution" effect) (Duval, 2003; Engelhardt & Kumar, 2009; Gruber & Orszag, 2003; Ranchhod, 2006). In the extreme case where the receipt of a pension is not income-tested and no contributions to the old-age pension system have to be paid (e.g. in New Zealand from age 65), the implicit tax on continued work is simply zero because the stream of pension payments remains unchanged whether the individual keeps working or not (Duval, 2003; Johnson, 2000). Although the study does not aim to differentiate these two effects, the conceptual distinction between income and substitution effects is crucial to welfare analysis (Autor & Duggan, 2007; Kaushal, 2014): if social pension system reduces labor supply through the substitution effect, this implies a deadweight loss; By contrast, reductions in labor supply due to the income effect do not imply a deadweight loss but rather an intended aspect of the policy since there is no distortion of incentives.

It is important to keep in mind that, the impact of social pension programs on the beneficiaries' labor supply behavior largely depends on the nature of the pension's contribution and benefit formulas. There are strong indications that the link between benefits and contributions matters for the incidence of contributions and, hence, the degree to which they are considered as taxes and thus distort markets (Ooghe, Schokkaert, & Flechet, 2003). Generally speaking, contributions are much less likely to be perceived as taxes, and the labor market distortions are reduced.

Obviously, the magnitude and direction of public pension plan parameters on labor supply behavior in developing countries vary tremendously across programs in developed countries because of the different policy environments and institutional arrangements. The NRPS of China is no exception. The unique feature of the NRPS may lead to a different behavior response of the elderly to the labor market. As described previously, the NRPS program is designed as two parts providing benefits to two different groups under different, but related, policy arrangements: one is a contributory scheme for those who must contribute in order to receive basic benefits when they reach age 60; and the other is a non-contributory scheme for rural elderly who are currently aged 60 + and embedded in NRPS with a "family binding" arrangement. But in any case, the basic benefits from NRPS are not means-tested and are not financed by the contributions of participants. In addition, the eligibility to receive basic benefits is not subject to requirement to retire, but primarily determined by an applicant's age. As a consequence, the effects of NRPS on the elderly labor supply may only result from a pure income effect (pension wealth) rather than comprehensive effects of income and substitution effects.

5. Data

The primary database used in this work is drawn from the China Health and Retirement Longitudinal Survey (CHARLS). These are nationally representative samples of Chinese residents ages 45 and older conducted by Peking University every two years. The baseline national wave of CHARLS was fielded in 2011, which included about 10,000 households and 17,500 individuals in 150 counties/districts and 450 villages/resident committees; and the first follow up survey wave was completed in 2013.

The data contained in the CHARLS datasets includes demographic and family structure information, health status and functioning, employment status and pension, income and assets, and other related information about respondents. Its rich information on employment and pension makes it ideal for analyzing labor force participation of the elderly. Since we are interested in exploring the relationship between the labor supply of the elderly and the social pension program, we restrict our attention to the subsample of the elderly in rural China, and further limit our sample to respondents who are aged between 50 and 70.[4] Furthermore, according to the eligibility rules of NRPS, the villages where NRPS has not been enforced are dropped from the analysis because the elderly labor supply behavior would not be affected by NRPS. Logically, it is not reasonable for those NRPS insurants aged below 60 and individuals without participating in NRPS to receive monthly pension payment, if it is the case, these samples will be dropped from the analysis.

With respect to the labor supply specification, we rely on the information of work, retirement, and pension module documented in CHARLS to define labor force supply behavior. In this data, individuals can be divided into three different types: one group is for those who are currently engaged in labor market activities, another group is for those who leave the labor force market but once worked at least three months in the past, and the other group is for those who have never worked during their lifetime. Obviously, the observations for individuals who have never worked will be deleted in that the exogenous public policies including NRPS would not have impact on their labor supply decisions. In this study, labor force participation of the elderly is measured as whether the individuals withdraw from the labor market or not. As a result, a dummy variable is defined to indicate if the respondents dedicated

[3] Earnings test means that pension benefit is paid only if the recipient's income falls below a certain level (Holzmann & Hinz, 2005). It is extensively acknowledged that this rule provides further incentives for people to reduce their labor supply when they become eligible to receive the pension and reflects the substitution effect of high implicit tax rate on earnings in the earnings test range (Gruber & Orszag, 2003; Ranchhod, 2006).

[4] On one hand, there is very little variation in their labor force participation behavior among the group of age below 50 and above 70; on the other hand, it is essential to restrict the sample aged between 50 and 70 to specify the regression discontinuity design model (see Section 6 for details).

themselves to activities in agricultural work, earning wage work, self-employed activities, and unpaid family business work[5]:The value is 1 for those who participate in the activities mentioned above when their total work hours in a year are equal to or more than 52 h; otherwise, the value is 0 for the individuals withdrawing from the labor market but once worked before and the individuals with total work hours less than 52 h in a whole year.[6] In addition, a continuous variable for the elderly to explore the intensity of work is measured as total work hours in one year in all jobs.

In line with the previous studies on labor supply of the elderly, some variables reflecting socio-economic and demographic characteristics of the respondents and regional heterogeneity are specified. As illustrated in numerous economics literatures, impaired health is identified as the principal determinant that makes the elderly withdraw from the labor market. Most studies use simple individual's self-assessed health status to examine the effect of health on work (Boskin & Hurd, 1978; Haveman, Wolfe, Kreider, & Stone, 1994). However, some potential drawbacks of this type of measure lie in the facts that: first, this measure results in justification bias introduced by Bound (1991), which means that non-working respondents may classify a given health problem as a more serious work limitation than working respondents, in other words, they may exaggerate their work limitations to justify that they don't work. Second, this measure may imply potential measurement error and endogeneity in individual responses to the general self-reported health questions (Disney, Emmersona, & Wakefield, 2006). In order to overcome these drawbacks, it is an obvious strategy to adopt more objective indicators of ill health in explaining the model "labor supply". Some researchers argue that restriction in (instrumental) activities of daily living ((I)ADLs) is a very good indicator of an individual's general health condition (Kalwij & Vermeulen, 2008),and ADLs or IADLs are less prone to the type of measurement error discussed above (Strauss, Gerlter, Rahman, & Fox, 1993). However, the limitations in physical activities that ADLs or IADLs typically capture occurred frequently in the senior elder groups, few relative young elderly have difficulty with these activities, and so ADLs or IADLs may not be useful in studies of health and labor outcomes (Strauss & Thomas, 1998). It is extensively recognized that most of countries in the world, including China, have experienced the disease transformation from acute infectious diseases to chronic diseases. The onset of chronic illnesses, in particular, Cardio cerebral vascular disease, has become one of the most predominant determinants of death, and hence brings huge economic burden on the middle-aged people. Consequently, knowledge of the nature and extent of links between chronic illnesses and labor market outcomes is more important for public policy. Following the argument discussed above, chronic disease conditions through physical examination or diagnosed by a doctor are employed in this study to analyze the effect of health on the labor outcome of the elderly. It is categorized into three groups:(1) has no chronic disease, (2) has hypertension disease, and (3) has other chronic diseases including dyslipidemia, diabetes, chronic lung diseases etc., but except for hypertension. As Li et al. (2014) point that this specification highlights some advantages: first, chronic diseases including hypertension are identified by physical examination or diagnosed by a doctor, and may not imply "justification bias"; second, hypertension, as a usual disease in the middle-aged, occurs mostly at the time that they do not yet withdraw from the labor market while facing retirement decisions, as a result, the observations have sufficient variation to satisfy the need of econometric model; third, High blood pressure leads to discomfort and is usually accompanied with symptoms such as dizziness and fatigue. Although it can impair people's capability to work, it does not prohibit them from working. In addition to health status, a set of demographic characteristics involved in the empirical analysis include age, gender, marital status, education attainment. Three dummy variables are used to categorize the respondent's education attainment at illiterate, primary school and under, and junior high school and above. Marital status is measured as a dummy variable to identify whether the individual is married with a spouse or not, and the reference is defined as non-married, which includes separated, divorced, widowed and never married. Farmland size and number of living adult children are introduced to reflect the potential impact of informal support such as land area and economic transfer from adult children on the elderly labor supply decisions. Furthermore, as suggested by the standard labor theory, we use present market value of owned house to control for wealth effect on the elderly labor supply. Finally, after excluding those elderly with relevant missing information, we retain a total sample of 7138 observations. The detailed variable definitions of interest and descriptive statistics are presented in Table 1.

As presented in Table 1, 68% of the respondents participated in the NRPS program in 2011 and 2013. Among NRPS enrollees, 43% of participants received old age pension payments (29% of the full sample). There are 495 and 481 samples that are aged 60 above but did not receive NRPS benefits in 2011 and 2013 respectively. On average, the labor participation rate of the elderly in rural China is 79% of total sample, and the sample mean differs by NRPS status and the respondents' age. The highest labor participation rate is found for those respondents whose ages are less than 60, and are NRPS insurants (86%). With regard to the labor time, as expected, NRPS enrollees work less than non-insurants. Considering the respondents who are older than 60, for example, the average labor time in a whole year for the NRPS insurants and non-insurants are 1147.14 and 1187.86 h respectively.

[5] Work does not include doing own housework or doing activities without pay, such as voluntary work. Theoretically, different types of work may have different labor intensity; the individual responsiveness of labor market behavior to pension incentives may vary according to different types of work. For instance, it is expected that social pension program might induce the elderly to substantially decrease the likelihood of engaging in physically strenuous work. For better understanding the welfare effect of social pension program on the elderly, it is necessary to separately examine the effect of pension incentives on his/her labor market behavior for different kinds of labor activities. However, this paper may not distinguish different kinds of work of rural elderly due to the limit of data source. In addition, it is relatively difficult for the rural elderly to transfer their work with different labor intensity in the labor market due to higher transformation cost. Therefore, under the framework of social pension program, the optimal decision for the elderly in rural China might be to leave the labor market or reduce their total working time. But this still needs further research.

[6] This is in accordance with the definition of China's National Bureau of Statistics and also applied in examining the effect of health on the labor supply of mid aged and older Chinese (Li et al., 2014).

Table 1
Variable definition and descriptive statistics.
Source: China Health and Retirement Longitudinal Survey (2011, 2013).

Group	Definition	Full sample		NRPS = 1				NRPS = 0			
				Age > =60		Age < 60		Age > =60		Age < 60	
Sample		7138		2105		2764		976		1293	
Variable		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
OAP	If the elderly received old age pension payment (= 1)	0.29	0.46	1	0	0	0	0	0	0	0
NRPS	If the elderly participated in the NRPS program (= 1)	0.68	0.47	1	0	1	0	0	0	0	0
Labor	If the elderly participated in labor market (= 1)	0.79	0.40	0.75	0.43	0.86	0.35	0.71	0.45	0.83	0.38
Labor_time	Total work hours (hours in one year)	1354.84	1292.18	1147.14	1197.74	1435.73	1270.44	1187.86	1261.44	1646.09	1429.96
Age	Age of the respondent (year)	59.31	5.47	64.76	2.67	55.27	2.99	64.44	2.82	55.21	2.94
Male	If the respondent is male (=1)	0.50	0.50	0.49	0.50	0.48	0.50	0.54	0.49	0.51	0.50
Spouse	If the respondent married with spouse (=1)	0.91	0.28	0.87	0.34	0.94	0.23	0.90	0.30	0.94	0.25
Illiterate	If the respondent has no formal education = 1	0.32	0.46	0.37	0.48	0.29	0.45	0.32	0.47	0.28	0.45
Primary school	If primary education or under of the respondent (=1)	0.44	0.49	0.51	0.50	0.37	0.48	0.54	0.49	0.39	0.49
Junior school	If junior high school or above of the respondent (=1)	0.25	0.43	0.12	0.33	0.34	0.47	0.14	0.34	0.33	0.47
Non_chronic	If the respondent has no chronic disease (=1)	0.39	0.49	0.27	0.45	0.39	0.49	0.43	0.49	0.54	0.49
Hypertension	If the respondent has hypertension (=1)	0.30	0.46	0.36	0.48	0.25	0.43	0.36	0.48	0.26	0.44
Other_chronic	if the respondents has other chronic diseases (=1)	0.30	0.46	0.37	0.48	0.37	0.48	0.22	0.41	0.19	0.39
Child	Number of adult children	2.78	1.20	3.31	1.28	2.41	0.91	3.22	1.34	2.39	1.04
Asset	Present market value of owned house (10,000 Yuan)	1.18	4.68	1.10	4.03	1.03	4.42	1.54	5.63	1.38	5.38
Land	Total land area distributed by collective (acre)	7.19	14.83	6.82	13.49	7.53	14.09	6.46	17.33	7.66	16.32
Dum_East	East region = 1	0.32	0.47	0.24	0.43	0.32	0.47	0.38	0.49	0.39	0.49
Dum_Middle	Middle region = 1	0.34	0.48	0.40	0.49	0.38	0.48	0.26	0.44	0.25	0.44
Dum_West	West region = 1	0.34	0.47	0.36	0.48	0.31	0.46	0.36	0.48	0.36	0.48
Dum_year	2013 = 1	0.68	0.47	0.79	0.41	0.77	0.42	0.49	0.50	0.44	0.49

6. Empirical strategy

In an attempt to identify the causal effect of the NRPS scheme on the labor supply decision of the elderly, some econometric issues have to be taken into consideration. First, as mentioned in section III, it is voluntary to participate in the NRPS program for all eligible rural residents and the decision of an individual to participate will be affected by his/her socio-economic characteristics and the characteristics of the region. Obviously, a host of individual, household and regional unobservable characteristics may simultaneously determine an individual's probability to participate in NRPS and labor market behavior. For instance, heterogeneity in risk preference and life expectancy, expected future income stability, and the trust level of the public program may lead to selection bias (or omitted-variable bias) and cause OLS estimates to be biased if not correcting the endogeneity bias. As a consequence, it is necessary to deal with the self-selection bias for the NRPS program on the elderly labor supply behavior. Second, to demonstrate the impact of the NRPS program, it is useful to make clear that which counterfactual group will be compared with the NRPS receipts. As presented in Fig. 1, non-recipients of NRPS payments include three groups of the elderly. A complete picture of the effect of the NRPS program on the elderly labor market behavior will be better demonstrated by comparing the NRPS recipients (region A) to all three NRPS non-recipients (i.e., regions B + C + D).

Over the last two decades, difference-in-difference and regression discontinuity design approaches have been extensively involved to identify the causal effect and evaluate the impact of a wide variety of social programs (Angrist & Krueger, 1999; Di Nardo & Lee, 2004). In this study, we combine the strengths of the regression discontinuity design, difference-in-difference method and inverse probability weighting method to investigate the casual effect of the NRPS program on labor supply. Our estimation strategies are addressed in two stages. In the first stage, we estimate a binary choice model for NRPS participation and then calculate the propensity score (i.e., predicted probability) that each respondent would participate in the NRPS program. The combination of RD-DiD method will be adopted in the second stage to estimate the labor supply equation, and to further correct for the potential endogeneity of NRPS participation on labor supply, the inverse of predicted probability of NRPS participation of each elderly is then used as the appropriate sampling weight for estimating the labor supply equation.

6.1. First-stage analysis of the NRPS program

Let $NRPS_i^*$ denote theunobserved latent variable of the NRPS program participation for the ith elderly, $NRPS_i$ is the observed counterpart, X_i is a vector of exogenous covariates, and τ is the vector of theassociated unknown parameters.μ_i is the random error. The binary choice model of the NRPS participation decision of the elderly can be specified as:

$$NRPS_i^* = X_i'\tau + \mu_i \text{ and } NRPS_i = 1\left[NRPS_i^* \geq 0\right]. \tag{1}$$

The probability of the program participation can be shown as:

$$\Pr(NRPS_i = 1|X) = \Pr\left(X_i'\tau + \mu_i \geq 0\right) = 1 - F\left(-X_i'\tau\right). \tag{2}$$

Under the normality assumption of μ_i, $F(\cdot)$ is a cumulative density function of the standard normal distribution. This exhibits frequently used form of binary probit model. Therefore, consistent estimates of τ in Eq. (2) can be obtained by implementing the maximum likelihood estimation method (MLE) (Wooldridge, 2010).

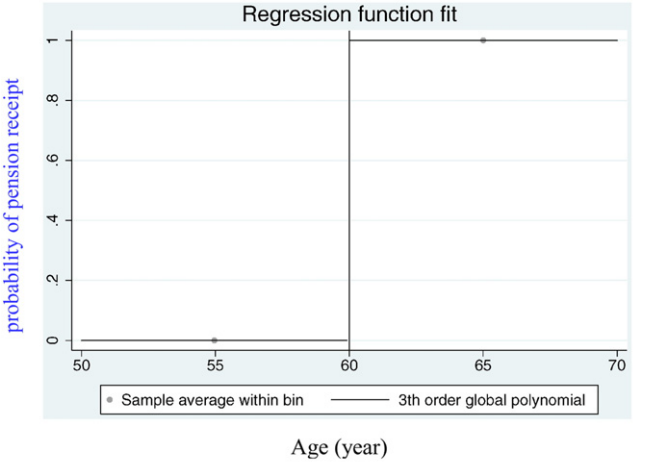
With the consistent estimates of the binary choice model of NRPS participation, the predicted probability of NRPS participation for each elderly ($P(NRPS_i = 1)$) is calculated. In accordance with the inverse probability weighting method, the sampling weights are then calculated as (see Chang, 2013; Funk et al., 2011; Robins, Rotnitzky, & Zhao, 1994):

$$PW_i = \sqrt{\frac{NRPS_i}{P(NRPS_i = 1)} + \frac{1 - NRPS_i}{1 - \hat{P}(NRPS_i = 1)}}. \tag{3}$$

The variable PW_i is applied as an appropriate sampling weight variable to correct for self-selection bias that is due to the NRPS participation decision when estimating the labor supply equation in the second stage analysis (see below).

6.2. Second-stage analysis for labor supply: RD-DiD framework

Since the late 1990s, regression discontinuity applications have increased in popularity: the attractiveness of such designs probably relies upon their similarity with a formal randomized experiment and the consequent perception that the identifying assumptions are relatively weak and plausibly hold in many circumstances (Hahn, Todd, & Van der Klaauw, 2001; Lee, 2008; Lee & Lemieux, 2010). The crucial feature of such design is that a treatment assignment of program is established according to the deterministic rule (or eligibility criterion). That is, individuals are assigned to a treatment group if and only if they exhibit a value of an observed pre-program characteristic not being below a specified threshold for the eligibility criterion. This implies that the probability of treatment receipt varies discontinuously at that threshold. The existing literature typically distinguishes two types of RD designs: the sharp design, in which all subjects receive their assigned treatment or control condition, and the fuzzy design, in which some subjects do not (Jacob, Zhu, Somers, & Bloom, 2012). In RD design, more thorough discussions, including theoretical developments as well as practical issues in implementation of RD methods, have been already illustrated by several papers in the literature (see Imbens & Lemieux, 2008; Jacob et al., 2012; Lee & Lemieux, 2010).



Source: China Health and Retirement Longitudinal Survey (2011, 2013).

Fig. 2. Probability distribution of pension receipt by age for NRPS participants.
Source: China Health and Retirement Longitudinal Survey (2011, 2013).

In the context of NRPS program in China, the determining rule for eligibility of pension payment is age rather than labor histories. As exhibited in Fig. 1, all of the NRPS participants are eligible to receive pension payment when they turn 60. It is straightforward to apply this eligibility rule in an RD study in that the probability of receiving pensions from the NRPS program changes discontinuously at the cut-point of age 60. The graph in Fig. 2 illustrates the relationship between forcing variable (respondent's age) and treatment status (pension receipt) for those NRPS participants, and provides intuitive information that the probability of receiving treatment jumps from zero to one as the forcing variable crosses the cut-point of 60.

6.3. A standard RD design for NRPS participants only

If we merely take the NRPS participants (regions A + B in Fig. 1) into account, a standard sharp RD design can be directly used because all of the NRPS participants aged 60 or above are eligible to receive pensions. Following Lee and Card (2008) and Chang (2013), consider the regression:

$$Y_i = \beta_0 + \beta_1 OAP_i + \delta(\alpha_i) + \gamma Z'_i + \varepsilon_i \tag{4}$$

where Y_i are the outcome variables of labor supply, i.e. labor participation and annual working hours in this study, for the ith individual, the effect of age on the outcome variables is captured by the function $\delta(\alpha_i)$, α_i indicates the respondent's age normalized to be zero around 60 (i.e. $\alpha_i = Age_i - 60$); $\delta(\alpha_i)$ is a polynomial function for α_i. Z'_i is a vector of the other exogenous determinants that are related to labor supply, and γ is a vector of the corresponding parameters. OAP_i is a treatment dummy variable that denotes two treatment statuses, and is defined as

$$OAP_i = \begin{cases} 1 & \text{if } Age_i \geq 60, \\ 0 & \text{if } Age_i < 60. \end{cases}$$

In this setting, the coefficient β_i captures the causal effect of the NRPS payment on labor supply. Consistent estimates of (4) can be obtained by implementing the Ordinary Least Squares (OLS) method.

6.4. The RD-DiD model for all rural elderly

Although the sharp RD approach can be applied to investigate the causal effect of the NRPS program on labor supply, the results are validated only when the sample of the NRPS participants is used. As discussed before, a complete picture of the NRPS program effect may be better exhibited by comparing the NRPS recipients to NRPS non-recipients.

To further illustrate the nature of combination of DiD method with the sharp RD analysis, Eq. (4) can be modified to the case in which both of the NRPS participants and non-participants are included to examine the causal effect of NRPS program on labor supply. The specification of the RD-DiD model can be defined as:

$$\begin{aligned} Y_i &= \beta_0 + \varphi_1 OAP_i + \delta(\alpha_i) + \varphi_2 NRPS_i + \varphi_3 I(Age_i \geq 60) + \gamma Z'_i + \varepsilon_i \\ &= \beta_0 + \varphi_1 NRPS_i * I(Age_i \geq 60) + \delta(\alpha_i) + \varphi_2 NRPS_i + \varphi_3 I(Age_i \geq 60) + \gamma Z'_i + \varepsilon_i. \end{aligned} \tag{5}$$

As indicated in Eq. (5), the second equality holds because all of the NRPS participants will receive the old age pension (OAP) payment when they arrive at age 60. Interestingly, several key effects can be identified from Eq. (5).First, the term ($\varphi_1 + \varphi_3$) captures the effect of labor supply between the elderly who are older than 60 and the elderly younger than 60 among the NRPS participants, all things being equal (that is, the difference between region A and region B in Fig. 1). Second, the term φ_3 examines the effect on labor supply between the elderly who are older than 60 and those who are younger than 60 among the NRPS non-participants, all things being equal (that is, the difference between region C and region D in Fig. 1). Therefore, the net effect of DiD method can be specified by the parameter φ_1. Furthermore, additional covariates reflecting the social economic characteristics and regional heterogeneity are also used in the model to eliminate small sample biases and improve the precision (Imbens & Lemieux, 2008; Imbens & Wooldridge, 2007).

It is crucial to note that the treatment group (i.e. NRPS participants) and control group (i.e. NRPS non-participants) are frequently exogenously determined in the standard DiD analysis. As mentioned previously, however, the individual's decision to participate in the NRPS program is voluntary, and it is unlikely to be exogenously determined. Consequently, it is imperative to correct for the potential selection bias due to NRPS participation decision when both of the NRPS participants and NRPS non-participants are used in the analysis. Following Dai, Chang, and Liu (2015) and Chang (2013), we adopt the inverse probability weighting method proposed by Robins et al. (1994) and Wooldridge (2007) to deal with this self-selection bias. In our study, the sampling weights (PW_i) calculated by probit model of NRPS participation equation (Eq. (3)) are used when estimating the RD-DiD model (Eq. (5)). Eq. (5) will be estimated by using OLS method for the dummy outcome variable of labor force participation and for the continuous variable of the total hours worked in all jobs, and the standard errors of the estimates are calculated by bootstrap method with replication of 100 times in order to measure the accuracy of the estimates of the treatment effects.

7. Empirical results

7.1. Determinants of NRPS participation decision

The estimation results and marginal effect of the exogenous determinants on NRPS participation specified in Eq. (2) are presented in Table 2. The socio-economic characteristics of the respondents including gender, impaired health and housing asset are significantly associated with the decision to NRPS program participation. A gender difference in the NRPS program participation decision of the elderly is also straightforward. Compared to female elderly, male elderly have a lower probability to participate in the NRPS program as indicated by the marginal effect of 2.55%. Consistent with conventional expectations, as a proxy variable for wealth, the present market value of housing asset plays a negative and significant role in the decision to participate in NRPS program at 1% statistical level. This indicates that the individuals with high housing wealth are less likely to participate in the NRPS program than other individuals. One possible explanation for this result is that those with higher wealth have sufficient economic capability to satisfy their needs and support themselves at the late life stage. On the other hand, there may be more alternative options for them to invest in other economic activities rather than purchasing public old age pension to secure their late livings due to its relatively low replacement ratio.

Furthermore, health status exerts significantly positive influence on the likelihood of enrollment in the NRPS program. In contrast to those individuals without any chronic disease, the elderly suffering from deteriorating health such as hypertension and other chronic diseases are positively correlated with the propensity to participate in the NRPS program. The estimation of marginal effects displays that the elderly with hypertension and other chronic diseases are more likely to enroll in the NRPS program with higher probability of 3.31% and 2.75% respectively.

Finally, to examine the location and time fixed effects, the regional dummy variables and the indicator of year are included in the analysis and also point to a significantly positive association with NRPS participation. The result indicates that, compared to 2011, the participation rate of NRPS program increases by 30.65% in 2013.

7.2. Graphical analyses of the NRPS program effect on labor supply

To identify the program effect of NRPS and to assess the credibility of the RD strategy, graphical analyses, as an integral part of any RD framework, provide an intuitive way to visualize whether there is any discontinuity around the threshold of the forcing variable. The graphics of Fig. 3(a)–(d) exhibit a visual assessment of the potential effect of the NRPS program on labor supply for NRPS participants and non-participants respectively, and cubic functional form is used to fit the data. Results indicate that labor supply differs by NRPS status. Although the discontinuity in total working hours for NRPS participants could not be clearly observed around age 60, a larger jump can be observed in the other three panels of graphics. Nevertheless, these results present a preliminary picture of the effect that the NRPS program has on labor supply without controlling for other covariates and without correcting for the self-selection bias.

7.3. Determinants of labor supply

The estimated coefficients of labor participation equation and total working hours equation are presented in Tables 3 and 4 respectively. In each equation, two types of bandwidth, i.e. 5-year age and 10-year age window around the cut point of age 60, are selected in attempt to conduct robustness and sensitivity test of the results to the choice of different bandwidth. Generally

Table 2
Estimation results of the NRPS participation equation (bandwidth = 10).
Source: China Health and Retirement Longitudinal Survey (2011, 2013).

Variable	Coefficient	SE	Marginal effect
Age	0.0007	0.0034	0.0002
Male	−0.0798**	0.0360	−0.0255
Primary school	−0.0542	0.0401	−0.0173
Middle school	−0.0388	0.0494	−0.0123
Spouse	−0.0703	0.0592	−0.0225
Hypertension	0.1025***	0.0395	0.0331
Other_chronic	0.0848*	0.0454	0.0275
Child	−0.0028	0.0148	−0.0010
Land	0.0016	0.0011	0.0005
Asset	−0.0094***	0.0034	−0.0030
Dum_Middle	0.4815***	0.0409	0.1525
Dum_West	0.1342***	0.0401	0.0458
Dum_year	0.8610***	0.0390	0.3065
Constant	−0.3031	0.1937	
Log likelihood = −4026.87	LR chi^2 (13) = 872.43		
Prob > chi^2 = 0.0000	Pseudo R^2 = 0.0977		

Marginal effect is evaluated at the sample means. dy/dx for factor levels is the discrete change from the base level.
*** Denotes the significance at the 1% level.
** Denotes the significance at the 5% level.
* Denotes the significance at the 10% level.

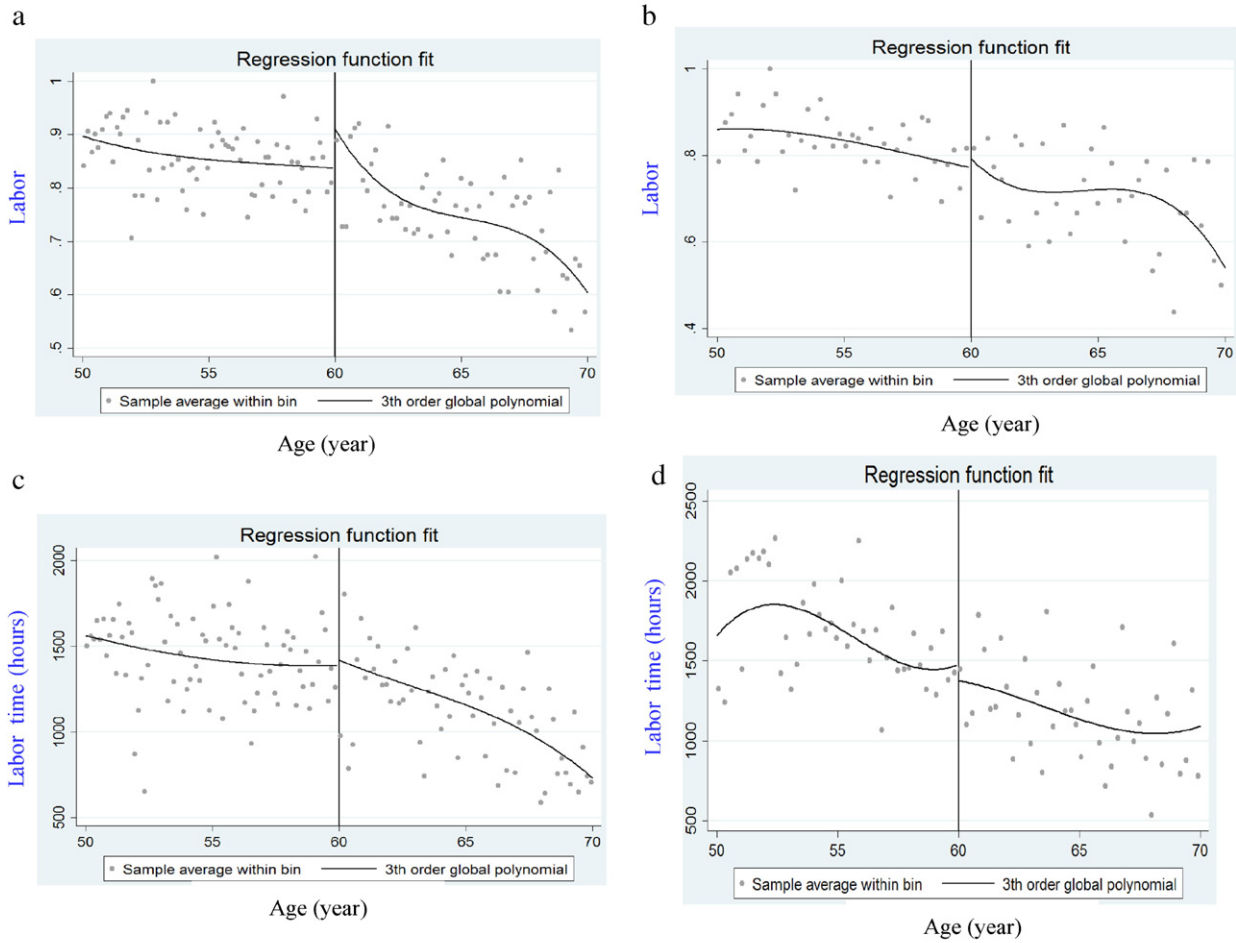


Fig. 3. (a) Labor participation over age for NRPS participants. (b)Labor participation over age for NRPS non-participants. (c) Total working hours over age for NRPS participants. (d) Total working hours over age for NRPS non-participants.
Source: China Health and Retirement Longitudinal Survey (2011, 2013) (Fig. 3(a)–(d)).

speaking, the results are very robust to the choice of different age window used in the estimation, and reinforce our considerable confidence in the findings. In addition, a second-order polynomial function is used to approximate the flexible function form of the normalized age in the empirical models.

Before turning to the impact of NRPS program on the decision of labor participation and total hours worked in all occupations, we focus first on the effect of the social economic variables on the elderly labor supply behavior. The results in Tables 3 and 4 indicate that, the male elderly are more likely to participate in the labor force market compared to the female counterparts and increase the time of work by 440.69 h per year, and the individuals being married with spouse are observed with a 8.76% higher probability to be in the labor force market and increasing labor time as indicated by the coefficient of 145.9 h.

As expected, the estimation result supports the hypothesis that the health status of the elderly is an important consideration in determining labor force behavior. Compared to the elderly without any chronic disease, the elderly with hypertension and other chronic diseases are significantly less likely to participate in labor force market by 9.48% and 1.88% respectively. With regard to hours of work in all jobs, the magnitude and significance of the health variable coefficient suggest that relatively poor health strongly reduces the individual's commitment to the labor market. In accordance with previous studies, these results confirm the fact that the impact of poor health acts as a strong deterrent to participate in the labor market (e.g., Kalwij & Vermeulen, 2008).

Socio-economic variables also exert a significant influence on labor supply of the aged. A highly negative association between number of adult children and labor supply of the elderly is found. The results show that an additional adult child will decrease the likelihood of labor participation by 1.83%, other things equal. This may reflect that, adult children, as an informal and traditional foundation of old age support source, will continue to shoulder the important supporting responsibility for their elder parents. Finally, the present market value of owned house also appears to have a significantly negative effect on the labor participation decisions of the rural elderly. Elderly individuals with higher asset levels may enjoy significantly more leisure in their old age.

Table 3
Estimation of the labor participation equation.
Source: China Health and Retirement Longitudinal Survey (2011, 2013).

Variable	Bandwidth = 5 (55–65 years)		Bandwidth = 10 (50–70 years)	
	Model 1	N = 4024	Model 2	N = 7138
	Coefficient	SE	Coefficient	SE
OAP(= NRPS * age > =60)	0.0165	0.0302	0.0130	0.0217
Age > =60	−0.0015	0.0347	0.0042	0.0244
NRPS	0.0708***	0.0178	0.0476***	0.0136
Age-60	−0.0099**	0.0046	−0.0100***	0.0018
(Age-60)^2	0.0004	0.0008	−0.0002	0.0002
Male	0.1241***	0.0142	0.1162***	0.0102
Primary school	−0.0177	0.0152	−0.0079	0.0126
Middle school	−0.0389**	0.0211	−0.0244*	0.0142
Spouse	0.0967***	0.0254	0.0876***	0.0237
Hypertension	−0.1166***	0.0176	−0.0948***	0.0115
Other chronic	−0.0343*	0.0193	−0.0188	0.0130
Child	−0.0192**	0.0079	−0.0183***	0.0046
Land	−0.0004	0.0005	−0.0003	0.0004
Asset	−0.0025**	0.0013	−0.0027**	0.0011
Dum_Middle	−0.0206	0.0171	−0.0069	0.0116
Dum_West	0.0230**	0.0153	0.0347***	0.0116
Dum_ year	−0.0233	0.0152	−0.0082	0.0058
Constant	0.8325	0.0324	17.2815	11.7751
Adjusted R^2	0.0658		0.0685	
Treatment effects				
(Age ≥ 60–Age < 60)|NRPS = 1	0.0151	0.0316	0.0172	0.0243
(Age ≥ 60–Age < 60)|NRPS = 0	−0.0014	0.0338	0.0042	0.0229
Net effect	0.0165	0.0302	0.0130	0.0217

Note: Standard errors are calculated by the bootstrapping method with 100 replications.
*** Denotes the significance at the 1% level.
** Denotes the significance at the 5% level.
* Denotes the significance at the 10% level.

Table 4
Estimation of annual work hours equation.
Source: China Health and Retirement Longitudinal Survey (2011, 2013).

	Bandwidth = 5 (55–65 years)		Bandwidth = 10 (50–70 years)	
	Model 1	N = 4024	Model 2	N = 7138
Variable	Coefficient	SE	Coefficient	SE
OAP(= NRPS * Age ≥ 60)	142.1285*	83.0051	172.9189***	66.6786
Age ≥ 60	−14.6348	100.8504	−39.5042	78.8705
NRPS	−38.1650	59.5855	−106.6471**	47.9109
Age-60	−40.9140***	14.2602	−40.0557***	5.1368
(Age-60)^2	0.0588	2.7511	−0.5472	0.5563
Male	488.5522***	41.1612	440.6911***	31.5323
Primary school	−42.7828	44.3646	−55.3294	38.4244
Middle school	−131.4398**	64.0212	−95.1525**	47.5533
Spouse	162.2588**	79.0495	145.9052**	58.7560
Hypertension	−326.3788***	54.9060	−300.7836***	35.6024
Other chronic	−96.0981	62.1663	−77.1331*	44.3205
Child	−33.3639	22.2374	−7.8189	16.4498
Land	−2.1386	1.9636	−1.0688	1.4292
Asset	−1.1508	4.4695	0.2918	3.6786
Dum_Middle	−177.1981***	53.1014	−244.7715***	39.2563
Dum_West	51.6319	47.8434	43.7928	33.4455
Dum_ year	−57.8538	45.3097	−67.9704*	39.5266
Constant	1462.349	93.7666	1470.6570	70.6417
Adjusted R^2	0.0639		0.0754	
Treatment effects				
(Age ≥ 60-Age < 60)|NRPS = 1	127.4936	86.6814	133.4147**	66.4695
(Age ≥ 60-Age < 60)|NRPS = 0	−14.6348	111.2287	−39.5041	73.2447
Net effect	142.1285*	83.0051	172.9189***	66.6786

Note: Standard errors are calculated by the bootstrapping method with 100 replications.
*** Denotes the significance at the 1% level.
** Denotes the significance at the 5% level.
* Denotes the significance at the 10% level.

From the policy point of view, the most interesting findings concern the effects of NRPS program on labor supply response of the beneficiaries. Several different treatment effects defined based on the comparison of the OAP recipients to different subgroups of OAP non-recipients are presented at the bottom of Tables 3 and 4. With respect to labor force participation decision, regardless of different types of bandwidth as shown in Table 3, the positive impact of pension receipt on labor force participation of the elderly is found. However, the net effect (i.e., DiD effect) of pension receipt from the NRPS program on the likelihood of labor participation is not statistically significant.

It is interesting to note that, the net impact of pension receipt on total working hours of the elderly is substantial and significant at 1% statistical level for the group aged between 50 and 70 years, while we find a quite small positive and significant effect on working hours for the group aged from 55 to 65 years. As presented in Table 4, the differences between the elderly who are older than 60 and those with age below 60 are 133.41 h and −39.5 h for NRPS insurants and non-insurants respectively, the net effect on total work hours is 172.91 h. These results imply that receiving pension income does not lead to a significant decline in old age labor force supply, and by contrast significantly increase the hours of work for the elderly.

Possible explanation for the results mentioned above may lie in a number of reasons: first,the payment amount of the old age pension and thereby the replacement ratio is not large enough to cause a dramatic work disincentive for the elderly. Second, as discussed by Albarran and Attanasio (2004), an important issue that is often neglected in the design of public programs targeted to the poor in developing countries, is the interaction of the proposed program with existing private arrangements. If public transfers largely crowd out private transfers, then the welfare impact of social redistributive programs will be smaller than perceived. The existing empirical results from rural China show strong evidence of crowding out the private intergenerational transfers from adult children (Cheng et al., 2013; Chen & Zeng, 2013; Zhang & Chen, 2014). As a result, the net economic welfare of the elderly has not been significantly improved given that the intergenerational transfers from adult children have been largely crowded out. The elderly in rural China have no choice but continue to work in order to maintain their living standards and sometimes need to work more in order to compensate the decreasing transfers from children. Third, the increase in labor time for those OAP recipients could be attributed to the specific policy arrangement such as “family binding” under the framework of NRPS program, which may strengthen the relationship between elder parents' entitlement to receive pension payment and their adult children' contribution obligation. Therefore, the conditionality of “family binding” may induce behavioral response in the elderly labor supply, dilute the pure benefit of the OAP recipients obtained from the NRPS program and hence lead to increase in total work hours. Thus, the design of public policies such as non-contributory old age pension needs further investigation in the future.

7.4. Heterogeneous effect of the NRPS program on labor supply

The heterogeneous results point to the importance of adequate targeting in order to maximize the impact and cost-effectiveness of the NRPS program. The conclusions drawn from impacts assessed by categorizing health status may be more useful to extend the coverage of NRPS program to the disadvantaged population because individual's health status is strongly associated with his/her consumption, income and labor supply behavior. Clearly, different health indicators may have a divergent impact on an individual's labor participation decision (Dwyer & Mitchell, 1999). While a severe health condition (e.g., cancer or stroke) may force an individual to leave the labor market, this may not be true for mild conditions such as high blood pressure. Therefore, it is essential to separately investigate the heterogeneous effects of the NRPS program on labor supply by different health conditions. Therefore, we also conduct an analysis to estimate three separate RD-DiD models (i.e. Eq. (5)) by dividing the whole population into three groups according to health status to examine the heterogeneous effects of the NRPS program on labor supply.

Table 5
Treatment effects estimation by different health status (bandwidth = 10).
Source: China Health and Retirement Longitudinal Survey (2011, 2013).

		Other chronic (N = 2252)	Hypertension (N = 2123)	Without chronic (N = 2763)
Labor force participation	(Age ≥ 60-Age < 60)|NRPS = 1	−0.0297	−0.0056	0.0897***
		(0.0344)	(0.0468)	(0.0323)
	(Age ≥ 60-Age < 60)|NRPS = 0	−0.0118	−0.0236	0.0381
		(0.0564)	(0.0468)	(0.0348)
	Net effect	−0.0178	0.0181	0.0516*
		(0.0473)	(0.0411)	(0.0303)
Total hours of work	(Age ≥ 60-Age < 60)|NRPS = 1	−110.579	241.7642**	267.0393***
		(103.6105)	(122.6153)	(100.9927)
	(Age ≥ 60-Age < 60)|NRPS = 0	−111.0809	115.5604	−84.9378
		(143.3524)	(112.7392)	(124.4010)
	Net effect	0.5018	126.2038	351.9772***
		(148.9444)	(111.0399)	(106.2364)

Note: The estimates of control variables are omitted. The standard errors are included in the parentheses and calculated by the bootstrapping method with 100 replications.
*** Denotes the significance at the 1% level.
** Denotes the significance at the 5% level.
* Denotes the significance at the 10% level.

As presented in Table 5, the impacts of the NRPS program on labor supply differ between individuals with different health status. Pension recipient from the NRPS program slightly decreases the probability of labor force participation, but increases the total hours of work for those individuals with other chronic diseases; however, the magnitudes are very small and not statistically significant. When turning to those individuals without chronic disease, the net effects of pension receipt on the likelihood of labor force participation and the total hours of work are significantly positive at statistical level of 10% and 1% respectively. By contrast, the pure effects for those with hypertension conditions are positive but not statistically significant. This suggests that the responsiveness of individuals' labor market decisions to the NRPS program varies considerably by different health status. Furthermore, it is reasonable that the net effects for the group with hypertension vary between the group with other chronic diseases and the group without chronic diseases. These results may provide strong evidence that the introduction and national coverage of the NRPS program has not been targeted in the sense of being responsive to the needs of this highly vulnerable group with bad health.

7.5. Robustness check: Fixed effect estimation combined RD with DiD method

In order to check the robustness of our main results, we offer in this section an alternative method to examine the effect of NRPS program on labor supply. With data available from two waves of the CHARLS, Eq. (5) can be modified to take individual-specific fixed effects into consideration. The individual-specific effects account for determinants that differ across individuals but that are time invariant, including observed characteristics (e.g. his or her gender and years of completed schooling), and unobserved determinants (e.g. expectations of NRPS benefit level, ability and heterogeneity in tastes for labor supply).[7] Although the endogeneity of participating in the NRPS program due to self selection bias, to some extent, could be corrected by inverse probability weight method, a correlation between the heterogeneity in preferences towards labor supply and pension incentives may also cause pooled OLS estimates to be biased. For instance, if the individuals with a preference for less likely participating in the labor market would be those who are more able to understand the rules of the NRPS program and are more involved in gathering information about benefits entitlements, then it could be the case that they would be more likely to receive the pension payment. In this case, cross-sectional estimates of the effects of the NRPS program on labor supply will be biased. If the omitted variables are important, we would expect the fixed-effects estimates to result in a smaller coefficient on the OAP variable compared to the magnitude of the OLS coefficient. Consequently, a balanced panel data with observations of 2816 is employed to run changes in labor supply on changes in receiving pension payment and changes in socio-economic characteristics that may change through time, and to estimate the fixed effects model combined regression discontinuity with difference in difference method.

As exhibited in Table 6, the key coefficients of the variable OAP are 0.0607 and 108.9031 for the labor force participation and total hours equation respectively. Compared to the main results as presented in Tables 3 and 4, a positive and significant relationship between pension receipt and labor force participation is found, while the effect of pension receipt on the total hours of work is positive but not statistically significant. In addition, there is a larger reduction in the magnitude of the pension receipt (OAP) coefficient for total working hours in the fixed-effects specification. This demonstrates that ignoring the likely correlation between retirement incentives coming through social security benefits and tastes for labor supply leads to an overestimation of the effects of pension incentives on labor decisions. Regardless of the difference in magnitude of OAP coefficients between two kinds of estimation methods, the robustness of our results to the choice of fixed-effect method gives us considerable confidence in the findings that, the NRPS program with some distinctive features in rural China does not play a significantly adverse role in labor supply of the elderly.

8. Conclusions

In this paper, we assess the impacts of the NRPS program on the elderly labor supply behavior using CHARLS data within the analytical framework of combining the strengths of regression discontinuity design, difference in difference approach and the inverse probability weight method. Results indicate that the NRPS program does not significantly reduce the likelihood of engaging in labor force market, on the contrary, the findings confirm that the NRPS program may dramatically contribute to increasing the total hours of work for the OAP recipients. Furthermore, given the importance of the impact of health on labor supply, the heterogeneous effects by health conditions suggest that the NRPS program slightly decreases the odds of labor force participation for those individuals in bad health condition; however, the effect is not statistically significant. In addition, the robustness check of estimates shows little sensitivity to the choice of sample and empirical method, and the fixed-effect specification performs very well when we control for unobserved heterogeneity.

The results of our research have important policy implications. On one hand, the findings suggest that extensive coverage of the NRPS program in China may not have the desired redistribution effect. In other words, from the perspective of labor supply, the public old age pension program does not improve the wellbeing of the elderly, in particular for those with bad health. It is clear that public transfers such as old age pension to the elderly without considering their health status may simply impoverish them. Our results strongly indicate that the labor supply of the elderly in bad health condition is of critical importance when implementing program evaluation for income support of the elderly. On the other hand, in the case of social old age pension, the effect of labor market

[7] It is mentioned that expected higher benefit level in future may induce people to reduce labor market participation. However, we argue that the expected benefits from the NRPS program will not be dramatically changed in the short term due to the two waves of CHARLS data. So, the effect will be differentiated through fixed effect model.

Table 6
Fixed effect estimation combined RD with DiD method (bandwidth = 10, N = 2816).
Source: China Health and Retirement Longitudinal Survey (2011, 2013).

Variable	Labor force participation equation		Total hours equation	
	Coefficient	SE	Coefficient	SE
OAP (= NRPS * Age ≥ 60)	0.0607*	0.0360	108.9031	119.4826
Age ≥ 60	−0.0210	0.0401	10.2051	133.143
NRPS	0.0089	0.0257	−166.9368*	85.3526
Age-60	−0.0350***	0.0082	−86.3547***	27.2633
(Age-60)^2	−0.0003	0.0006	−1.9799	1.9975
Spouse	0.1538*	0.0908	471.2509*	301.331
Hypertension	−0.0198	0.0286	109.4050	95.1559
Other chronic	0.0392*	0.0228	135.0905*	75.6899
Child	0.0192	0.0166	−9.5033	55.1744
Land	0.0005	0.0006	4.6125**	1.8851
Asset	−0.0026	0.0018	−7.9716	6.0141
Constant	0.5956	0.0984	943.1817	326.6689
R^2	0.0247		0.0244	

*** Denotes the significance at the 1% level.
** Denotes the significance at the 5% level.
* Denotes the significance at the 10% level.

outcomes on the elderly could be confounded with the behavior response of the private transfers from adult children and the program's conditionalities. The results suggest that labor market effects should be taken into consideration in the design of welfare programs in developing countries, including China, and that the evaluations of such programs should seek to better understand the underlying mechanisms at work.

Although increasing labor force participation rates among older workers improves the fiscal stability of pension systems which does matter in developed world, a crucial question that has been largely neglected by policy makers concerns the effect of later retirement on individual well-being, in particular, on health, and hence directly affects health care costs at ages. Consequently, the social security policies may be formulated to focus on the older elderly and the elderly with bad health, and improve their wellbeing by appropriately increasing the payment amount of pensions in rural China; meanwhile, the reform needs to focus on institutions and tools that minimize distortion on labor supply for the working-age adults.

Acknowledgments

This study is sponsored by the National Natural Science Foundation of China (Project No. 71303050) and the China Scholarship Council (Project No. 201406655015).

References

Albarran, P., & Attanasio, O. P. (2004). Do public transfers crowd out private transfers? Evidence from a randomized experiment in Mexico. In S. Dercon (Ed.), *Insurance against poverty, part VI* (pp. 281–304). Oxford: Oxford University Press.
Angrist, J. D., & Krueger, A. B. (1999). Empirical strategies in labor economics. In O. C. Ashenfelter, & D. Card (Eds.), *Handbook of labor economics, volume 3, part A, chapter 23* (pp. 1277–1366). Elsevier.
Ardington, C., Case, A., & Hosegood, V. (2009). Labor supply response to large social transfers: Longitudinal evidence from South Africa. *American Economic Journal: Applied Economics*, *1*(1), 22–48.
Autor, D. H., & Duggan, M. G. (2007). Distinguishing income from substitution effects in disability insurance. *American Economic Review*, *97*(2), 119–124.
Baker, M., & Benjamin, D. (1999). How do retirement tests affect the labor supply of older men? *Journal of Public Economics*, *71*(1), 27–51.
Benjamin, D., Brandt, L., & Fan, J. (2003). Health and labor supply of the elderly in rural China. *William Davidson Institute Working Paper No. 579* (Available at SSRN: http://ssrn.com/abstract=417820).
Bertrand, M., Mullainthan, S., & Miller, D. (2003). Public policy and extended families: Evidence from pensions in South Africa. *World Bank Economic Review*, *17*(1), 27–50.
Blau, D., & Goodstein, R. (2010). Can social security explain trends in labor force participation of older men in the United States? *Journal of Human Resources*, *45*(2), 328–363.
Boskin, M. J., & Hurd, M. D. (1978). The effect of social security on early retirement. *Journal of Public Economics*, *10*(3), 361–377.
Bosworth, B., & Burtless, G. (1998). Population aging and economic performance. In B. Bosworth, & G. Burtless (Eds.), *Aging societies: The global dimension* (pp. 1–32). Washington, DC: Brookings Institution Press.
Bound, J. (1991). Self-reported versus objective measures of health in retirement models. *Journal of Human Resources*, *26*(1), 106–138.
Cai, F., Giles, J., O'Keefe, P., & Wang, D. -W. (2012). *Old-age support in rural China: Challenges and prospects*. Washington, DC: World Bank, Directions in Development.
de Carvalho Filho, I. E. (2008). Old-age benefits and retirement decisions of rural elderly in Brazil. *Journal of Development Economics*, *86*(1), 129–146.
Case, A., & Deaton, A. (1998). Large cash transfers to the elderly in South Africa. *The Economic Journal*, *108*(450), 1330–1361.
Chang, H. H. (2013). Old farmer pension program and farm succession: Evidence from a population-based survey of farm households in Taiwan. *American Journal of Agricultural Economics*, *95*(4), 976–991.
Chen, T., & Turner, J. A. (2014). Extending social security coverage to the rural sector in China. *International Social Security Review*, *67*(1), 49–70.
Chen, H., & Zeng, Y. (2013). Who benefits more from the new rural society endowment insurance program in China: Elderly or their adult children? *Economics Research*, *8*, 55–67.
Cheng, L., Zhang, Y., & Liu, Z. (2013). Does the new rural pension scheme remold the elder care patterns in rural China? *Economics Research*, *8*, 42–54.
China Health and Retirement Longitudinal Survey (CHARLS), http://charls.ccer.edu.cn.

Dai, Y., Chang, H. H., & Liu, W. (2015). Do forest producers benefit from the forest disaster insurance program? Empirical evidence in Fujian Province of China. *Forest Policy and Economics*, *50*(1), 127–133.
Di Nardo, J., & Lee, D. S. (2004). Economic impacts of new unionization on private sector employers: 1984-2001. *Quarterly Journal of Economics*, *119*(4), 1383–1441.
Disney, R., & Tanner, S. (2000). *The abolition of the earnings rule for UK pensioners. IFS Working Papers, No. WP 00/13*London, UK: The Institute for Fiscal Studies.
Disney, R., Emmersona, C., & Wakefield, M. (2006). Ill health and retirement in Britain: A panel data-based analysis. *Journal of Health Economics*, *25*(4), 621–649.
Dorfman, M. C., Holzmann, R., O'Keefe, P., Wang, D. -W., Sin, Y., & Hinz, R. (2013). *China's pension system: A vision.* Washington, DC: World Bank, International bank for Reconstruction and Development.
Duflo, E. (2003). Grandmothers and granddaughters: Old age pension and intra-household allocation in South Africa. *World Bank Economic Review*, *17*(1), 1–25.
Duval, R. (2003). The retirement effects of old-age pension and early retirement schemes in OECD countries. *OECD Economics Department Working Paper No. 370.*
Dwyer, D. S., & Mitchell, O. S. (1999). Health problems as determinants of retirement: Are self-rated measures endogenous? *Journal of Health Economics*, *18*(2), 173–193.
Edmonds, E. V. (2006). Child labor and schooling responses to anticipated income in South Africa. *Journal of Development Economics*, *81*(2), 386–414.
Engelhardt, G. V., & Kumar, A. (2009). The repeal of the retirement earnings test and the labor supply of older men. *Journal of Pension Economics and Finance*, *8*(4), 429–450.
Floro, M. S. (1995). Economic restructuring, gender and the allocation of time. *World Development*, *23*(11), 1913–1929.
Friedberg, L. (2000). The labor supply effects of the social security earnings test. *The Review of Economics and Statistics*, *82*(1), 48–63.
Funk, M. J., Westreich, D., Wiesen, C., Sturmer, T., Brookhart, A., & Davidian, M. (2011). Doubly robust estimation of causal effects. *American Journal of Epidemiology*, *173*(7), 761–767.
Gruber, J., & Orszag, P. (2003). Does the social security earnings test affect labor supply and benefits receipt? *National Tax Journal*, *56*(4), 755–773.
Gruber, J., & Wise, D. A. (1998). Social security and retirement: An international comparison. *American Economic Review*, *88*(2), 158–163.
Gruber, J., & Wise, D. A. (2007). *Social security programs and retirement around the world: Fiscal implications of reform.* Chicago: The University of Chicago Press.
Gustman, A. L., & Steinmeier, T. L. (1986). A structural retirement model. *Econometrica*, *54*(3), 555–584.
Hahn, J., Todd, P., & Van der Klaauw, W. (2001). Identification and estimation of treatment effects with a regression-discontinuity design. *Econometrica*, *69*(1), 201–209.
Haveman, R., Wolfe, B., Kreider, B., & Stone, M. (1994). Market work, wages, and men's health. *Journal of Health Economics*, *13*(2), 163–182.
Hofer, H., & Koman, R. (2006). Social security and retirement in Austria. *Empirica*, *33*(5), 285–313.
Holzmann, R., & Hinz, R. (2005). *Old Age Income support in the 21st Century: An international perspective on pension systems and reform.* Washington, DC: World Bank.
Hurd, M. D., & Boskin, M. J. (1984). The effect of social security on retirement in the early 1970s. *Quarterly Journal of Economics*, *99*(4), 767–790.
Imbens, G., & Lemieux, T. (2008). Regression discontinuity designs: A guide to practice. *Journal of Econometrics*, *142*(2), 615–635.
Imbens, G., & Wooldridge, J. M. (2007). *What's new in econometrics?* NBER Summer Institute: Mini-course lecture notes (available at http://www.nber.org/WNE/).
Jacob, R., Zhu, P., Somers, M., & Bloom, H. (2012). A practical guide to regression discontinuity. *MDRC Working Paper.* New York: MDRC (http://www.mdrc.org/publication/practical-guide-regression-discontinuity).
Johnson, R. (2000). The effect of old age insurance on male retirement: Evidence from historical cross-country data. *Working Paper 0–09*. Federal Reserve Bank of Kansas City, Research Division.
Juarez, L. (2010). The effect of an old-age demogrant on the labor supply and time use of the elderly and non-elderly in Mexico. *The B.E. Journal of Economic Analysis & Policy*, *10*(1), 1–27.
Kalwij, A., & Vermeulen, F. (2008). Health and labor force participation of older people in Europe: What do objective health indicators add to the analysis? *Health Economics*, *17*(5), 619–638.
Kaushal, N. (2014). How public pension affects elderly labor supply and well-being: Evidence from India. *World Development*, *56*(4), 214–225.
Kinsella, K., & Velkoff, V. A. (2001). An Aging World: 2001. *International Population Reports.* Washington, DC: U.S. Bureau of the Census.
Lee, D. S. (2008). Randomized experiments from non-random selection in U.S. House Elections. *Journal of Econometrics*, *14*(2), 675–697.
Lee, D. S., & Card, D. (2008). Regression discontinuity inference with specification error. *Journal of Econometrics*, *142*(2), 655–674.
Lee, D. S., & Lemieux, T. (2010). Regression discontinuity designs in economics. *Journal of Economic Literature*, *48*(2), 281–355.
Li, Q., Lei, X., & Zhao, Y. (2014). The effect of health on the labor supply of mid-aged and old Chinese. *China Economic Quarterly*, *13*(3), 917–938.
Lumsdaine, R. L., & Wise, D. A. (1994). Aging and labor force participation: A review of trends and explanations. In Y. Noguchi, & D. A. Wise (Eds.), *Aging in the United States and Japan* (pp. 7–42). Chicago: University of Chicago Press.
National Bureau of Statistics (2011). The sixth national census in 2010 main data bulletin. 2011, http://www.stats.gov.cn/tjsj/tjgb/rkpcgb/qgrkpcgb/201104/t20110428_30327.html
Ooghe, E., Schokkaert, E., & Flechet, J. (2003). The incidence of social security contributions: An empirical analysis. *Empirica*, *30*(2), 81–106.
Pang, L., de Brauw, A., & Rozelle, S. (2004). Working until you drop: The elderly of rural China. *The China Journal*, *52*, 73–94.
Ranchhod, V. (2006). The effect of the South African old age pension on labor supply of the elderly. *South African Journal of Economics*, *74*(4), 725–744.
Robeyns, I. (2003). Sen's capability approach and gender inequality: Selecting relevant capabilities. *Feminist Economics*, *9*(2–3), 61–92.
Robins, J. M., Rotnitzky, A., & Zhao, L. (1994). Estimation of regression coefficients when some regressors are not always observed. *Journal of the American Statistical Association*, *89*(427), 846–866.
Ruhm, C. J. (1996). Do pensions increase the labor supply of older men? *Journal of Public Economics*, *59*(2), 157–175.
Strauss, J., Gertler, P. J., Rahman, O., & Fox, K. (1993). Gender and life-cycle differentials in the Patterns and determinants of adult health. *Journal of Human Resources*, *28*(4), 791–837.
Strauss, J., & Thomas, D. (1998). Health, nutrition, and economic development. *Journal of Economic Literature*, *36*(2), 766–817.
United Nations (2010). *World population ageing 2009.* New York: The United Nations, Department of Economic and Social Affairs, Population Division.
Vere, J. P. (2011). Social security and elderly labor supply: Evidence from the Health and Retirement Study. *Labor Economics*, *18*(5), 676–686.
Wooldridge, J. (2007). Inverse probability weighted estimation for general missing data problems. *Journal of Econometrics*, *141*(2), 1281–1301.
Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data* (2nd ed.). Boston: The MIT Press.
Zhang, C., & Chen, B. (2014). Can Public pension system substitute family mutual insurance? *Economics Research*, *11*, 102–115.
Zunzunegui, M. -V., Alvarado, B. E., Del Ser, T., & Otero, A. (2003). Social networks, social integration, and social engagement determine cognitive decline in community-dwelling Spanish older adults. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *58*(2), S93–S100.