Lund Papers in Economic History

No. 139, 2015

Population Economics

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DEPARTMENT OF ECONOMIC HISTORY, LUND UNIVERSITY

Lund Papers in Economic History
ISRN LUSADG-SAEH-P--15/139--SE+36

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Orders of printed single back issues (no. 1-65)
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Full-text electronic issues (no. 58, 60, 61, 66--)
www.ekh.lu.se

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Abstract

Transitioning into retirement is an under-researched phenomenon in developing countries. Largely, this is linked to a predominance of contexts where – in particular – the rural population remains outside the coverage of any formal pension system. In 2008, China introduced the New Rural Social Pension (NRSP), a program which by now covers the majority of the Chinese rural elderly. This paper examines the effects of the NRSP on the labor supply of the elderly in rural China. As pension benefit eligibility at the time of its implementation is conditional on age, a regression discontinuity design is applied to investigate the casual effect of the receipt of pension benefits on labor supply. Furthermore, as the NRSP is neither means-tested nor conditions on retirement, it induces a pure income effect on employment. Using data from the China Health and Retirement Longitudinal Study, a nationally representative data set, we find that the receipt of pension benefits increases the probability of retirement among the rural elderly by around 15%.

JEL Classification:
H55 Social Security and Public Pensions
J26 Retirement

Keywords: China, New Rural Social Pension, Labor supply, Regression discontinuity, Retirement

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Acknowledgements

We are grateful to the participants of the First China-Sweden Workshop and the Economic History seminar, Lund University, 2014. We especially thank Albert Part for hosting Zeyuan Chen at Hong Kong University of Science and Technology (HKUST) in 2015. This paper has benefited from the helpful comments from the empirical micro-development group seminar at HKUST. We also thank Dominik Hangartner for helpful comments and suggestions regarding the empirical strategy of the paper. We acknowledge National School of Development, Peking University for providing the CHARLS data. Zeyuan Chen acknowledges financial support from Stiftelsen för främjande av ekonomisk forskning vid Lunds Universitet, the Jan Wallander and Tom Hedelius Foundation, and the Swedish Research Council. Tommy Bengtsson and Jonas Helgertz gratefully acknowledges financial support from the Centre for Economic Demography Linnéaus grant (2006:79), financed by the Swedish Research Council.

1. Introduction

The determinants of individuals' decision to retire represent an under-studied phenomenon in many developing countries. This despite it being relevant to many crucial development issues, such as social support and poverty reduction. In China, the rural elderly has since long been described as subjected to "ceaseless toil" (Benjamin, Brandt and Fan 2003; Davis 1991) due to a lack of sufficient old age provision, frequently causing them to work until they are physically incapable to continue doing so. Until recently, the decision to retire in rural China has mainly been considered to be determined by the individual's health, and not influenced by public policy. The implementation of the comprehensive New Rural Social Pension (NRSP) scheme, taking place between 2009 and 2012, therefore represents an event of potentially fundamental importance for the rural Chinese. More specifically, the NRSP – today implemented across the country – for the first time in history offers Chinese rural residents nationwide the possibility to enjoy pension benefits. By exploiting the nature of the implementation of the NRSP, this study analyzes how the labor supply of the elderly was affected by the exogenously generated increase in income, though a regression discontinuity design, for using the China Health and Retirement Longitudinal Study (CHARLS) 2011/2012.

The introduction of the NRSP provides an opportunity to disentangle the causal influence of access to pension benefits on the labor supply of the Chinese rural elderly. Individuals, who are aged 60 and above are entitled to pension benefits, which on average amount to about 10% of an average annual income in rural China. In particular, participants who signed up for the NRSP when they were already over 60 could claim pension benefit without having previously contributed to any pension plan. This study offers several contributions to existing literature. Firstly, as the introduction of NRSP represents a quasi-natural experiment, the receipt of pension benefits provides a source of exogenous variation in income. Using a regression discontinuity design, we are therefore able to investigate the casual effect of income on the labor supply of the Chinese rural elderly. Although a number of emerging countries have extended pension provision to previously uncovered populations, the evidence on the retirement effects of pension systems from developing countries is still scarce. Understanding the effect on labor supply is valuable, as many of the improvements in pension systems aim to reduce poverty. Our study provides important insights into how the elderly's wellbeing is affected by the pension provision.

Secondly, the receipt of pension benefits from the NRSP generates an income effect. This is important, as the receipt of pension incomes frequently influences retirement behaviors through both income and substitution effects. More specifically, pension benefits represent additional incomes and thus facilitate retirement (income effects). Pension programs may, however, also encourage retirement by effectively imposing a tax on work (substitution effects). This is especially so when the receipt of pension benefits is conditional on an earnings-test, meaning that only individuals with earnings below a given threshold are eligible. Individuals may thereby choose to work less in order to keep the household income low. Another scenario is represented by when pension eligibility requires the individual to withdraw from the labor market, thereby providing an additional incentive to retire. With the existence of these substitution effects, individuals will compare their wages and their potential pension benefits and choose the optimal strategy. If pension benefits exceed their expected earnings, they will choose to retire. Since individuals in rural China who are eligible for

pension benefits through the NRSP are neither subjected to an earnings test nor required to retire as a result of pension benefit receipt, the NRSP does not contain any such incentives to leave the labor force. As NRSP participants under age 60 are subjected to a pension premium, it may induce an incentive for them to work for higher pension benefits later. Nevertheless, withdrawal from the labor force in the 50s is not common in rural China. The income effect is therefore expected to play the main role.

Thirdly, this paper is one of the first to investigate the behavioral responses of individuals as a result of exposure to the NRSP. The rural pension intends to provide a higher living standard for the rural elderly and offer them opportunities to retire without losing too much of their economic well-being. If the pension benefits, however, predominantly separate the younger elderly from labor force, it may exacerbate the labor shortages brought by population ageing in the rural areas. In their study in Chinese, Zhang, Giles and Zhao (2014) examines several outcomes besides labor supply, also choosing a different age in defining the discontinuity beyond which individuals are considered as treated.

The paper is structured as followed: section two summarizes previous findings in the literature, from China and elsewhere, and section three provides an overview of the pension system in China in general as well as outlining the details of the NRSP. The subsequent section discusses the data and methods, whereas section five presents the results of the empirical analysis. Section six presents a series of robustness checks, with the discussion and conclusion being provided in section seven.

2. Previous research

A substantial literature has studied the effects of access to various social benefits on individuals' labor supply in developed countries, with one of the largest empirical challenges being to obtain a measurement of such incomes that may be considered to be exogenous to the individual. Several studies have exploited the influence of various policy changes in various types of benefits on a range of individual decisions, on contexts such as the U.S (Costa 1995; Krueger and Pischke 1992), Germany (Puhani and Tabbert 2011), and Canada (Lemieux and Milligan 2008). In general, increased social benefits have been found to lower the labor supply of the beneficiaries.

Despite such findings, the conclusions from analyses of developed countries may only have limited relevance for developing countries, due to substantial differences in terms of institutional setting, resource availability and policy focus (Kaushal 2014). Many recent social security reforms in developed countries have aimed at mitigating the social burden created by the ongoing and future process of population aging. For example, the cutting of pension benefits in many countries since the mid-1990s has created incentives for later retirement, and thereby typically also extended the working life. In contrast, many old age support programs in the developing world have poverty reduction as a primary aim and attempt to offer the elderly poor the possibility to retire at a younger age and to be less reliant on intergenerational transfers. Also, with poorly functioning financial markets, people are typically unable to borrow money and thus retire earlier through consumption smoothing.

The study of the impact of pension provision on individuals' labor supply in developing countries remains a comparatively limited field. Analyzing the expansion of South Africa's pension program to also include the black population during the early 1990s, Ranchhod (2006)

finds a significant decrease in employment among the beneficiaries. The exceptional generosity of the program for the newly covered population, with benefits being roughly twice the beneficiaries' average income, was also found to influence the behavior of other family members living in multi-generational households. Ardington, Case and Hosegood (2009) also examines the South African context, and find that access to pension benefits facilitates the employment of prime-aged adults. The pension benefits thus allowed the elderly to retire earlier and be more involved in childcare, also lifting credit constraints and allowing for the provision of financial help for the job seekers to moving out. Hence, granting pension benefits to the elderly may also influence the behavior of other family members, not directly affected by the pension scheme. Examining the Indian context, Kaushal (2014) documents that the old age pension scheme has a modest but negative impact on the employment of male elderly. Despite that the effects observed in both South Africa and India are in accordance with à priori expectations, it needs to be underlined that both programs are earnings-tested. Consequently, the estimates contain both income and substitution effects.

Instead, other developing countries have offered opportunities to isolate the income effect on retirement behavior from various social benefit reforms. This is particularly the case when the pension systems have a non-contributory nature. Juarez (2010) estimates the impact of an old age benefit program targeting individuals over the age of 70, providing a compensation level amounting to around 30% of the recipients' average income. The findings suggest a negligible labor supply response, linked to the already quite low employment rate among individuals in the target group already prior to the implementation of the reform. de Carvalho Filho (2008) exploits a pension reform in Brazil in 1991 that both reduced the minimum age for the payment of benefits as well as an increasing benefit level. In terms of elderly employment, the findings indicate a large negative response as a result of the policy intervention. The largest effects are found among rural men, where those who receive pension benefits are observed with a 38% increased risk of retirement. Danzer (2010) studies a generous pension reform that induces a threefold increase in pension benefits in Ukraine, resulting in a 30-47 percent increase in retirement probability.

2.1 Retirement behavior in China

Existing studies on retirement behavior in China are predominantly of a descriptive nature. The rural and urban Chinese have starkly different sources of old-age support, which is arguably also reflected in their retirement behavior. In 2005, 45% of the urban elderly above the age of 60 considered pension benefits as their primary source of financial support, while the corresponding share among the rural elderly only amounted to about five percent (Giles, Wang and Zhao 2010). Instead, 54% of the rural elderly population considered support from their family members as the main income source and 38% mainly lived off their own labor income. Unsurprisingly, labor income is comparatively more important for the younger elderly (age 60-70), with family support being more important for those above the age of 70.

Giles, Wang and Cai (2011) furthermore show that urban residents retire at a younger age and in general receive comparatively substantial pension benefits. The retirement decision for urban residents is thus more similar to those observed in developed countries. Women also typically retire earlier than men. In contrast, rural residents tend to have a considerably more extended working life. Davis (1991) was first in describing Chinese rural residents as

subjected to "ceaseless toil", attributing their extended working lives to an insufficient elderly support system. Using the China Health and Nutrition Survey (CHNS) collected during the 1990s, Benjamin et al. (2003) confirmed that the concept of "ceaseless toil" was an accurate description for the conditions experienced by the rural elderly. Despite generally increasing incomes during the 1990s, the elderly could still not afford to retire from labor-related activities any earlier. Instead, a deteriorating health emerged as the main reason for a reduction in men's working hours. For women, this effect was considerably less pronounced; with women instead tending to work more when their husbands' health fails. Household wealth also plays a role, with men in richer families retiring earlier, further strengthening the argument suggesting that financial constraints represent a core factor preventing the rural elderly from retiring from the labor force.

More recent studies reveal that the employment rates among the Chinese rural elderly gradually have been increasing during 1990s and early 2000s. Based on the 2009 CHNS survey and the 2008 CHARLS survey, Giles et al. (2011) show that 86% of the men and 57% of the women aged 60-64 are still working. Even at the age of 70, over 65% of men and 40% of women still continue to work. In general, education appears to be a facilitator for the elderly to retire, with the exception being women with a high school degree. This is explained by this group being disproportionately found to be working in village adminstration or running small enterprises, both of which are not very physically demanding. In line with Benjamin et al. (2003), they also find that pension income depresses the labor supply of older famers. Cai et al (2012) outlines a complex picture when it comes to the role of the presence of children on the labor supply of the elderly. The migration of adult children frequently results in remittances to the elderly and thus reduces the incentive to work. Meanwhile, it increases the work burden among the elderly parents who do remain working. This is particularly so in some areas where non-productive land will be reallocated by the village administrative unit. The elderly may thus have to work in the farm in order to keep the land. The net result is one where having migrant children increases the likelihood to work among older farmers (Cai et al 2012).

As regards the effects of the implementation of the NRSP, only a few studies are known to the authors. In an article in Chinese, Zhang et al. (2014) examine a range of outcomes, also applying a regression discontinuity design. Their findings indicate that receiving pension increases the probability of retirement by 25%[1]. The pension benefits also have influences on other family members. Eggleston, Sun and Zhan (2014) apply a regression discontinuity design to survey data fielded in the Shandong province in July 2012, finding that the children of pension recipients are more likely to out-migrate.

3. Pension programs in rural China

Until 2009, existing comprehensive pension systems in China exclusively covered urban employees. Although pilot programs aiming to provide pension benefits to the rural elderly had been introduced previously, they were never fully implemented. One program was initiated during the early 1990s, and - after a series of various pilots - the basic schemes were established in 1995. The scheme was designed to mainly be financed by individuals' contributions and supplemented by the collectives, with the state providing assistance when needed. The rural pension expanded quickly after the finalization of its design 1995, reaching

its peak in 1998. However, the rural pension schemes had several limitations. As it was pooled at county level, the poor areas had limited ability to finance it. Meanwhile, the high inflation during the late 1990s made it difficult to maintain the value of funds. With concerns about its sustainability and effectiveness, the central government realized that China had not been ready for universal rural pensions and terminated the rural pension plan in 1999 (Chen and Wang 2010).

3.1. The New Rural Social Pension Insurance (NRSP)

The New Rural Social Pension Insurance (NRSP)[2] was launched in late 2009. At the introduction of the NRSP, it only covered about ten percent of the Chinese counties, expanding rapidly during the following years. By the end of 2010, 24% of all counties were covered and 143 million persons had signed up (Ministry of Labour and Social Security 2011), representing approximately 22 percent of the rural population. One year later, NRSP had been implemented in 60% of the counties, covering 359 million rural Chinese (approximately 60 percent). By the end of 2012, NRSP had achieved full geographic coverage (Ministry of Labour and Social Security 2013) .

The structure of the NRSP consists of social pooling based pension (basic pension) and individual accounts. The social pooling basic pension is paid by the government, while the individual account is financed by both individual premiums and government subsidies. Rural residents who are aged 16 and above and not covered by an urban employee pension program are eligible for signing up. The insurance premium displays a certain geographic variation, typically ranging from 100 to 500 yuan per year[3]. The subsidies to the individual accounts, provided by the government, are correlated with the premium level paid by the individual. Despite these incentives to participate, the NRSP remains a voluntary pension program, where rural residents both choose whether to enroll as well as the payment level of the premiums. The latter being linked to the pension benefits received once having retired.

The age of eligibility for the receipt of pension benefits is 60[4]. The rules of the NRSP stipulate that those who sign up when they are under 45 have to pay the premiums continuously for at least 15 years before they can claim any pension benefits. Instead, residents who are age 45 and above are only required to pay the premiums continuously until they reach the age of 60. Participants who contribute with pension premiums before they retire receive both the basic pension and benefits they have accumulated from their individual account. Participants who were already past the age of 60 when the NRSP was introduced in their region of residence are immediately entitled to basic pension benefits without paying a premium[5]. In most provinces, receiving benefits is, however, conditional on the enrollment of eligible children[6].

In less developed regions, the central government fully finances the basic pension benefits, whereas the local government will finance up to 50% percent in China's more developed provinces. The lower bound of the benefits obtained through the basic pension has been set by the central government to 55 yuan (9 USD) per month. The local governments can adjust the compensation level upwards. Some more developed provinces have a substantially higher basic pension level, amounting for example to 280 yuan per month in Beijing. In general, however, the basic pension remains between 55 and 60 yuan per month. Differences in the compensation level are also reflected in average incomes across rural China. Overall, the

average income per person in 2011 was roughly 7,000 yuan in rural China (National Bureau of Statistic 2012). In provinces such as Beijing, Jiangsu and Zhejiang, the rural annual average income per capita is above 12,000 yuan, to be compared with less than 5000 yuan in comparatively more backwards parts of western China. Having considered these aspects, the basic pension provided through the NRSP on average translates to a compensation level amounting to around ten percent of an average annual income. As the elderly generally have lower income compared to the prime-aged generation, the pension income is expected to constitute a larger share of their income.

4. Methods

4.1 Data

We analyze the 2011/2012 wave of the CHARLS survey, created through interviews with a sample of 17,500 individuals, clustered within 10,250 households and residing in 28 of China's 33 provinces (Zhao et al. 2013). CHARLS is managed by the Institute of Social Science Survey (iSSS) at Peking University, and it aims to cover a nationally representative sample of Chinese residents ages 45 and older, in to serve the needs of scientific research on the elderly. CHARLS includes information on demographic, socioeconomic and health characteristics of the elderly, as well as information on living arrangements and intergenerational transfers. The interviews for the 2011/2012 wave of the CHARLS typically took place between May 2011 and March 2012, and responses pertain to individual and household behavior during the preceding twelve months. The data provides the year and month of the interview, with the precise date arbitrarily set by the authors to be the 15th day of the month, thus defining the twelve-month observation period. Besides providing information on the household and the individual level, a community survey is also provided. This is of importance for this study, as it contains information on the timing of the implementation of the NRSP.

4.2. Identification strategy

We use a regression discontinuity approach (RD) to exploit a discontinuity in the probability of receiving treatment (NRSP benefits) occurring as the individual turns 60. Regression discontinuity design was pioneered by Thistlethwaite and Campbell (1960) as a non-experimental approach to estimate treatment effects when the treatment status is determined by whether the value of a rating variable falls above a known threshold (cutoff point). Lee (2008) formally illustrates that the RD design is as credible as randomized experiments as long as candidates have imprecise control over the rating variable near the threshold. Therefore, the direction and magnitude of the change in the outcome near the cutoff point is considered as the causal effect of treatment.

The analysis is restricted to regions that had introduced the NRSP at the start of the observation period, thus twelve months prior to the interview date. Compliance is not complete, as i) the NRSP is voluntary and ii) younger family members[7] also need to sign up. Consequently, the probability of treatment does not go from zero to one as the individual crosses the age-eligibility threshold. As a result, the change in the relationship between the outcome and treatment can no longer be interpreted as an average treatment effect. An

instrumental variable (IV) approach can, however, be used to recover the full treatment effect. More specifically, the exogenous assignment to treatment eligibility (through age) can be used to instrument individuals' actual participation in the NRSP. We apply a fuzzy RD approach, where models are estimated by means of two stage least squares regression (2SLS).

$$(1) T_i = \alpha + \gamma_0 D_i + f(age_i) + \theta X_i + \varepsilon_i$$
$$(2) Y_i = \alpha + \beta_0 \hat{T}_i + f(age_i) + \theta X_i + \varepsilon_i$$

The first stage equation (1) estimates actual treatment (NRSP receipt, T_i) as a function of treatment eligibility (D_i). Individuals younger than 60 (older than 60) at the time of the survey are observed with a treatment eligibility of zero (one). In order to interpret the intercept of estimates, the rating variable age is centered at the cut-off point 60. Hence,

$$\mathrm{D_i} = \begin{cases} 1 \text{ if centered age}_\mathrm{i} \geq 0 \\ 0 \text{ otherwise.} \end{cases}$$

The first stage also controls for age (centered at age 60), as well as a vector of controls, X_i. The second stage equation (2) predicts the outcome as a function of NRSP receipt, instrumented through $\hat{T}_i$, obtained from the first stage. Otherwise analogous to the first stage, the equation controls for the function of age, a vector of individual characteristics as well as an error term. The vector of control variables is included to generate more robust results, but it is not required for achieving an unbiased RD design (Jacob et al. 2012). Hence, adding control variables should not alter the results greatly.

4.3. Sample

In generating the study population, the first step consisted of selecting rural communities that had introduced the NRSP at the start of the observation period. The communities in which NRSP was introduced during the duration of the observation period are excluded, as there is likely to be a time lag between implementation and those eligible actually signing up and starting to receive benefits[8]. As the community survey only provides the year of NRSP introduction, we rely on the information from the individual survey to construct the launch month of NRSP. Hence, communities which claim to have introduced the NRSP but without any observed pension benefit recipients are excluded (N=16). The earliest enrollment date in each community is considered as the introduction date of NRSP. At the start of the observation period, NRSP has been launched in 118 communities from 24 provinces out of 450 communities covered in CHARLS. The coverage rate of 26% is in line with the national implementation progress of NRSP.

Since rural residents could only join the NRSP in their *hukou*[9] location, we excluded the respondents without local *hukou*. Also, respondents who are enrolled in other pension programs are dropped. We further restrict the sample to respondents who are between 50 and 70 years of age at the time of the survey. After aforementioned sample selection criteria have been applied, 2,919 individuals remain.

4.4. Variables

Table 1 presents variable means. The dependent variable is a rough but comprehensive indicator of the individual's participation in work during the preceding twelve months. In constructing the variable, we consider both paid agricultural work (household agricultural work and being employed as a farm laborer) and off-farm work (earning a wage, running own business and conducting unpaid family business work, etc.). If a person engages in agricultural work for more than ten days in the past year or works at least one hour during the last week, they are considered as still being working. This is also the case if an individual has a job but is temporarily not working. According to this definition, out of the 2,919 respondents in the sample, 2,316 are characterized as actively working. In the control group (age<60), the share of individuals are still active in work amounts to 84 percent, whereas the corresponding figure for the treated group amounts to 73 percent.

Also displayed in the table are the individual demographic characteristics that are controlled for in the analysis, including sex, marital status, health status and educational level. Marital status is defined as married or non-married, where non-married includes separated, divorced, widowed and never married. Health status is measured as whether respondents have any functional limitations. Individuals who have difficulties in conducting activities of daily living (ADLs) or instrumental activities of daily living (iADLs) are considered as functionally limited[10]. Clearly correlated with age, it is expected that poor health reduces the propensity to work. Education is defined as the highest level of education the respondent has attained, overall indicating an on average relatively low level of schooling, consistent with the rural Chinese context. The variable distinguishes between the illiterate, those with primary schooling or below, as well as middle school and above. As expected, people in the younger cohort have higher education. In the treated group, 35% of the individuals are illiterate, and 53% only attained primary school. As education is a measure of long term earnings and wealth accumulation ability, it is expected to be negatively related to the probability of working[11].

- Table 1 about here

The data also allows for controlling for several relevant household characteristics. Having adult children indicates potential access to support for the elderly and may thus reduce the probability of working. While the majority of the younger elderly (aged 50-59) have two or three adult children, over 50% of the elderly in their 60s have three or more adult children. Clearly, the older cohort has more children, which is in line with the decline in fertility since 1970s. On the other hand, having young children potentially implies increased expenses, as young children are net consumers, and may thereby increase the probability of working[12]. Only very few of respondents have children under age 16 in both groups. Those elderly who have *grandchildren* under the age of 16 may be likely to have retired from the labor force. By taking a greater responsibility in raising the young generation, the intermediate generation may maximize their own labor supply, resulting in an optimization of overall productivity. The data also reveal a considerable degree of multigenerational living arrangements, where 28 percent of the respondents in the control group live with pre-school grandchildren, compared to 18 percent among the older cohort.

5. Results

Initially, we attempt to establish the existence of a discontinuity in treatment probability at the expected cut-off point, essential for the validity of the empirical design of this study. Figure 1 shows that receiving NRSP benefits is correlated with age, and with a substantial upward shift at the age of 60. This, combined with the less than perfect compliance, as evidenced by the take-up rate not exceeding sixty percent, supports the appropriateness of a fuzzy regression discontinuity design. Also note the comparatively low proportion of individuals receiving pension benefits at age 60, something that could be expected, as individuals who turned 60 shortly before the interview date may have not started to claim pension benefits. From the age of 61 and onwards, the share of the sample receiving NRSP benefits constantly hovers at around 50 percent.

- Figure 1 about here

- Figure 2 about here

Equally important for the validity of the RD-design, Figure 2 illustrates the proportion of individuals who remain working according to the definition used in this paper, by age. In line with the hypothesis that the implementation of the NRSP generated an exogenous income increase, the discontinuity in the labor supply that can be observed at age 60 tentatively confirms the existence of a second stage. For people aged 51-59, the employment rates are stable at around 85 percent, dropping by around 10 percentage points at the age-threshold, remaining fairly constant thereafter. The one exception being the proportion still working at age 70, the sensitivity to which the analysis thoroughly examines.

Table 2 presents the estimates from the regression discontinuity models. Besides the treatment variable, Model 1 only contains the centered age variable, estimated as a linear spline function. The interaction term of age and the treatment variable is included to allow the influence of age to be different in two sides of the threshold. Model 2 is extended to control for individual demographic and socioeconomic characteristics. The last model adds controls for family characteristics, as well as county specific characteristics, through a set of dummy variables. While we remain convinced that the best model fit is obtained using a linear specification of age, a number of additional specifications are presented in a subsequent robustness analysis.

- Table 2 about here

As expected, the effect of crossing the age-threshold and thus becoming eligible for NRSP benefits has a positive and significant influence on actual benefit receipt, as estimated in the first stage. Furthermore, the point estimate remains stable across all model specifications. Turning to the effect of receiving NRSP benefits on labor supply, instrumented by being at least 60 years of age, the basic Model 1 suggests a 14.4% decrease in probability of working, being statistically significant at the 10% level. This influence becomes slightly attenuated in more extended Models 2 and 3, but remains statistically significant and with a point estimate

ranging from 13.2% to 16.2%[13]. The consistent direction and magnitude across the different model specifications thus suggest a significant treatment effect. More specifically, the income effect generated by receiving pension benefits significantly reduces the probability of remaining working by about 15%. Our result is in accordance with other studies on developing countries, having found that the receipt of pension benefits significantly reduces elderly labor supply. The magnitudes of the effects are, however, less than those obtained from Brazil and Ukraine, something which could be linked to the pension programs in these two countries being more generous than the NRSP. Our estimates are also smaller than Zhang et al. (2014)'s results (around 25%), which is largely due to the different model specifications. In their study, age 60.75 is used as the discontinuity point where the proportion of receiving pension benefit has the strongest jump. The elderly age 60.25 and 60.5 are excluded. On contrast, we use the age 60 as the discontinuity point, since the NRSP participants have the possibility to receive pension benefit once they reach age 60. Meanwhile, the regression discontinuity estimates rely heavily on the observations near the threshold. Eliminating observation right above the cutting point may bias the results. Hence, it is crucial to take all the elderly above age 60 into account.

An interpretation of our result could be related to the restrained credit situation which rural elderly in China typically face, something that might explain their high overall propensity to remain working. Table 3 shows various distributional statistics regarding annual income and expenditure in our sample. The average annual income in our sample is considerably lower than the national average rural income that was previously reported (5,000 yuan). The main reason is that the rural elderly here examined has lower income compared to that for the prime-age population reported in the official statistics. In the sample, the average individual annual income[14] amounts to 4112 yuan, however characterized by a quite large standard deviation. In this occasion, the average NRSP pension benefit of 60 yuan per month constitutes around 18% of the sample's mean annual income. If we instead consider the median income, amounting to 1240 yuan, the average annual pension benefit of 720 yuan emerges as over half of the income. Moreover, the first quartile of individual annual income is 400 yuan. Consequently, for at least 25% of rural elderly, the pension benefits are large enough to enable them to retire without having any effect on the individual's standards of living.

- Table 3 about here

Model 2, in Table 2, adds a full set of individual demographic characteristics. As expected, women are less likely to be active working than men, and married individuals are observed with a 15.8% higher probability to participate in the labor force. Respondents with functional limitations are 25.6% less likely to work, consistent with previous findings suggesting that declining health increases the probability of retirement. Compared to the illiterate elderly, respondents who have attained at least secondary schooling are 6.1% less likely to work. The impact of education is non-linear, which is in accordance with Giles et al. (2011). This could be indicative of educated individuals having higher earnings potential and thereby being able to accumulate wealth over the life cycle, allowing them to retire earlier.

When family characteristics and regional dummies are included in Model 3, the

coefficients of individual demographics remain largely similar. As expected, having children under the age of 16 increases the probability of working. The number of grandchildren under age 16 doesn't matter. The effect of adult children is non-monotonic. Compared to those who have two adult children, elderly without adult children are 12.1% less likely to work. Having more than four adult children lowers the likelihood of working. Co-residence with children and young pre-school grandchildren do not have significant impacts on the respondents' probability of working[15].

6. Robustness checks

While the main specifications previously presented indicate a consistent and significant influence of NRSP benefits on the probability of retiring, it remains a possibility that the results are driven by an incorrect specification of the forcing age variable. Thus, a range of models with different specifications of age are presented in Table 4, again otherwise analogous as the main Model 3. The reported parameter is again the coefficient of interest obtained from the second stage estimation, the effect of the instrumented NRSP benefit receipt on the individual's labor supply. The third column includes models estimated on the identical sample as having been discussed to this point. The first two models includes different functional forms of age, but constrain the slope of the relationship between age and labor supply to being identical at both sides of the age-threshold at age 60. The last two models in the column include interactions between age and treatment, in order to allow the slope to vary at respective sides of the cutoff point. More specifically, the age-effect after the age of 60 may be different for individuals depending on whether they receive NRSP benefits. This is particularly important when observations from very far away from the threshold are included. All the estimates are negative and statistically significant. Receiving pension lowers the likelihood of being working by 16.0% to 36.8%. Although there are variations in the magnitude, most of the coefficients are around 16%. The consistent effects from different specifications show the robustness of our results. The linear interaction model yields similar magnitude compared to the linear model. All the coefficients of interaction terms are insignificant (not shown in the table), which indicates that the slope of the regression line is not significantly different on either side of the cut-point. Transitioning from the linear model to the quadratic interaction model, the complexity of the regression model increases while the power of the analysis decreases. Due to the limited sample, we prefer the linear interaction model.

- Table 4 about here

Another way to investigate the robustness of the results is by narrowing the observation window, thus examining a time period which is increasingly restricted to immediately before and after the exposure to the treatment. The basic idea is that the outermost observations may have substantial effects upon the relationship between the rating variables and outcome. Hence, we want to assess whether the treatment effect is sensitive to the exclusion of those observations. Using smaller windows also better captures the spirit of the regression discontinuity design. Here, the observation window is gradually reduced to contain 8/5/3 years before and after the age threshold at age 60. Again, the results are shown in columns 2-4

in Table 4. Overall, the results are quite robust regardless of the age window. The direction of the effects is consistently negative, although the magnitude varies. Particularly, the size of the effects becomes larger when we narrowing the width, which indicates that the labor supply has a significant discontinuity at age 60. Most estimates are significant at the 10% significance level, with insignificant results most likely being largely linked to a gradually decreasing sample size. Across the models applying the preferred linear spline specification of age, the influence of NRSP benefit receipt on the probability of remaining working ranges between 16 and 24 percent.

A series of manipulation tests are conducted to assess the exogeneity of the treatment. The foundational assumption of regression discontinuity design is that individuals are unable to "perfectly manipulate" the treatment. The validity of the RD design is challenged if respondents could find a way to cheat their age to obtain the pension benefits, e.g., people aged 59 claiming that they are 60. In this case, the people who claim to be 60 may be systematically different from those who are just below the threshold. This could induce a spurious link between age and the error term and thus generate biased estimates. The manipulation could also happen if people above age 60 migrate to the areas where NRSP has been introduced to join the pension program. This is unlikely given NRSP is only available for people with a local *hukou and* the change of *hukou* is quite restricted in China.

Figures 3a-3b show the density of observations on age and the enrolment rate of NRSP by age. If perfect manipulation indeed existed, we should have observed a drop at 59 or a jump at 60 in the density, something that clearly is not the case. Starting from age 58, the number of observations by age has a clear downward trend, which is in line with the CHARLS full sample where the number of respondents peak at age 58. Another problem that may generate biases is that people wait until they reach age 60 to join the pension program. The enrollment rate of NRSP over age experiences high fluctuation without any clear trend.

- Figure 3a-b about here

McCrary (2008) proposes a formal test to check whether such manipulation exists. A Wald test is applied to examine whether the density of rating variable (age in this case) has a discontinuity at the threshold. The null hypothesis is that the discontinuity of the shares of people in different age groups is zero. Local linear regressions are conducted separately for the density function below and above the cutoff point, and we find no evidence that the predicted log density at the age 60 from those two regressions is significantly different (p-value 0.120). Hence, we cannot reject the null hypothesis that there is no discontinuity at age 60.

Another assumption of the RD design is that the functional form of the rating variable $(f(age_i))$ is continuous without the treatment. This assumption implies that the pension eligibility should be the only source of the drop around age 60. This might be violated if people intend to stop working at age 60 regardless of pension provision. Based on previous studies and knowledge about rural China, this is not likely. Giles et al. (2011) shows the employment rate across different age groups based on CHNS 2009. Starting from age 50, the employment in rural area declines gradually with age, without any drastic drop around age 60. Hence, there is no reason to expect a discontinuity around age 60 in absence of pension

benefits.

In order to formally test this, we use data from areas where NRSP has yet to be introduced by the time of the survey. The sample analyzed is otherwise similar to that in the main analysis, thus consisting of respondents living in rural areas, with a rural *hukou* and not covered by any other pension programs. Figure 4 outlines the labor supply change across age for this population. Compared to the main study population, no discontinuity in the share of being active workers is visible at age 60. Instead, the proportion of still working individuals gradually decreases from their late 50s. The probability of remaining working among the elderly drops faster than our NRSP sample, especially after age 65. As mentioned above, the pilot program of NRSP has prioritized poor regions. It is expected that the elderly living in the NRSP areas tend to retire later than other areas. If the labor supply of elderly in the non-NRSP areas does not change significant near age 60, it is unlikely to happen to their counterparts in poorer regions without the introduction of NRSP.

- Figure 4 about here:

The fuzzy regression discontinuity and two stage least square approach is used to deal with the partial compliance problem in the main study sample. The reduced form of 2SLS could be seen as a sharp design assuming all respondents over age 60 sign up for NRSP. In the areas that NRSP has not been introduced we have to assume that all the individuals signed up for the pension. A sharp regression discontinuity is applied to investigate whether the probability of working has a discontinuity around age 60. Table 5 shows the results from sharp regression discontinuity estimation. To make the comparison, we run the same model using the NRSP sample. We apply various specification of age and window width. Although the directions are negative, none of the estimates is statistically significant at a 10% confidence level. Without the presence of NRSP, the work status of rural residents does not have discontinuity at age 60. This result provides additional robustness to our argument that the discontinuity of labor supply at age 60 in the main sample is caused by the pension program.

- Table 5 about here

We also examine the discontinuity of other covariates at the cut-off point. There are no other variables that causing the different outcomes in two sides of the cut-off point. Rather, they should be continuous around the cut-off point. The discontinuity in labor supply around age 60 may also result from the decline in health status or increase in educational level. Figures 5a-5b illustrates the educational level and the proportion having a functional limitation, across values of the centered age variable. The level of education has a downward trend over age with fluctuations between age 60 and 65. The fraction of having functional limitation remains stable until age 65. Generally, both of them have no obvious discontinuity around age 60. Furthermore, we do not find a clear discontinuity in any other covariate, including marital status and number of children.

- Figure 5a-b about here

As a final robustness check, we assign placebo age-thresholds in order to test whether the relationship between pension receipt and labor supply is spurious. Following Eggleston et al. (2014), the age 59 is chosen. There are two reasons to choose this special age. The first is to investigate whether the reduction in labor supply is indeed caused by the pension eligibility or by other age-related covariates. Elderly who are 59 cannot receive pension benefits, but their characteristics are similar to those aged 60. If the relationship between the placebo age cutoff and the outcome does not exist, we can more confidently argue that the negative link that was found in the main analysis is not spurious. Secondly, this procedure allows for the examination whether the elderly exit labor market before they actual receive the pension benefits. More specifically, if people anticipate that they will have pension income later on, they may smooth the consumption and retire earlier, also violating the exogeneity assumption of the NRSP according to this study design.

Age 61 is also chosen to perform the placebo test. The employment rate drops in both age 60 and 61 (see Figure 2). Therefore, one may be concerned that the discontinuity in the work status is not sharp, as the probability of receiving pension also jumps at age 61[16]. Table 6 provides the regression discontinuity estimates, using age 59 and age 61 as the cutoff point. We use the preferred linear specification for both the reduced form regression and 2SLS regression, controlling for covariates. Neither estimate is significant, as well as being small in size. Thus, it additionally corroborates the negative relationship previously obtained between receiving pension and labor supply.

- Table 6 about here

7. Conclusions

The purpose of the paper was to investigate the effects of the NRSP pension reform that was gradually introduced across Chinese provinces from 2009 to 2012. The reform made individuals residing in rural areas past the age of 60 eligible for benefits of 55 or 60 yuan per month, corresponding to a non-trivial share of the examined individuals' income. Exploiting the features of the program, we applied a regression discontinuity design to study the impact of pension benefit receipt on the elderly labor supply. Given that NRSP benefits are neither subject to an earnings-test nor provides any retirement incentives, it is argued that the pension benefits mainly generate an income effect on employment.

The estimates show that the receipt of pension benefits has a sizable negative effect on the rural elderly's labor supply. Depending on the model specification, the likelihood of remaining working decreased by between 13.2% and 36.8%. The size of the effect is similar to those reported by Zhang et al (2014), hovering at around 25 percent. The results are in accordance with Davis (1991)'s view that the lacking financial resources is the main reason for the "ceaseless toil" in rural China. The NRSP provides additional income for the elderly and offers them the option to retire. When given the opportunity of pension, there is a 15% increase in the probability of retirement. In this regard, it may indeed be improving the wellbeing of rural Chinese.

Our result is in line with the studies from other developing countries like Ukraine and Brazil (Danzer 2010; de Carvalho Filho 2008). An increase in pension income causes decline in old age labor supply. Since even the income effects have sizable negative influences on

elderly labor supply, the poverty-reduction program need to take the negative labor supply response into consideration. On the other hand, the overall labor supply response also depends on the policy effects on the prime-age population. The public transfers may crowd out the private intergenerational transfers from adult children. Thus it mitigates the burden on adult children. The retired elderly could spend more time on taking care of grandchildren and thus allow their children to moving out. The evaluations of pension program need to take all those aspects into account.

Notes

[1] The different size of effects compared to our results is largely due to different model specifications we use.

[2] A schematic presentation is provided in Table A1, Appendix.

[3] In some richer provinces the categories of premium could be up to 1000 yuan per year.

[4] The only exception is Beijing where the eligible age of pension benefit is 55 for women and 60 for men. Until 2011, women above the age of 55 living in some counties in the Jiangsu province were eligible.

[5] As they did not pay any pension premium before, they won't receive any money from individual accounts.

[6] One may expect that the number of children or co-resident children should effect the probability of receiving pension benefits for the elderly aged 60 and above, which will raise selection problems. Using both of them as independent variables, we find that they do not have significant influence.

[7] Family members here refer to those who have *hukou* within the same household. The *hukou* system is a mandatory household registration system in China. It officially identifies the area a person resides and basic demographics such as name, birthdate, sex, marital status and education level. There are two type of hukou status: agriculture and non-agriculture. Hukou is assigned at birth based on parents' hukou status. Generally, the change of hukou is quite restricted. It normally occurs in the occasion of marriage, entrance to high education and job changes. See Wu et al. (2004) for more details.

[8] Sensitivity analyses have been performed also including such regions. As expected the estimated parameters for the effect of pension benefit receipt and labor supply are consistently smaller in magnitude, but without changing the conclusions.

[9] See footnote 5

[10] See Lawton and Brody (1969) for the definition and measurements in ADL and iADL.

[11] Due to data limitations, wealth is not controlled in the model. One possible indicator of wealth is saving. As over 70% of respondents report no saving, it does not provide much information. Housing wealth could be seen as an important part of household wealth. However, current data from CHARLS does not allow us to construct this variable.

[12] The cut-off point of young children is set to be age 16. The 9-year compulsory education (primary and secondary school) has become free since 2007, which has increased the enrollment rate of secondary school in rural China. Rural children normally start schooling at age 6 or 7. They are unlikely to contribute much in the household agriculture work while receiving education. Rural youth normally start to work after finishing secondary school. Thus, we set the age 16 or above as adult children.

[13] Considering potential unobserved factors at the community level, we perform a separate model that controls community fixed effect and cluster standard errors at the community level. The estimate results remain similar.

[14] The individual income consists of an individual' wage income, public transfer income and asset income. Household level public transfers per capita and household agriculture income per capita are included.

[15] In order to examine if there are heterogeneous effects regarding the influence of receiving pension benefits, we have run separate models by sex, educational attainment and number of adult children. As expected, the negative impact of pension benefits on labor supply is more pronounced among women and the elderly with elementary education or under.

[16] As the receipt of pension benefits may not represent a sharp discontinuity, we apply an alternative assignment rule to capture the exact exposure to the pension benefits. People who are under age 60 and above age 61 are assigned 0 and 1, respectively. For respondents who

are between age 60 and age 61, the exposure is calculated as the days since their 60^{th} birthdate divided by 365. We apply this fuzzy assignment rule using both the reduced form regression and 2SLS regression. The estimates are still consistent with our main result, although the magnitudes become a bit smaller.

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Tables

Table 1: Variable means

	Treated (Age 60-69)	Control group (Age 50-59)
Current working (%)	73.0	84.2
Receiving pension benefits (%)	48.3	0.0
Age (distance to age 60)	4.5	-4.6
Gender (%)		
Male	48.9	49.5
Female	51.1	50.5
Married (%)	86.6	93.2
Functional limitation (%)	17.8	13.6
Education (%)		
Illiterate	35.0	30.8
Elementary school or below	53.0	40.5
Secondary school and above	12.0	28.6
Having children under 16 (%)	0.7	3.8
Number of adult children (%)		
0	1.9	3.6
1	7.2	16.2
2	21.4	42.7
3	27.4	25.8
4	24.8	8.5
5 or more	17.4	3.2
Number of grandchildren under 16 (%)		
0	10.0	18.3
1	15.7	25.9
2	20.8	22.9
3	17.3	12.7
4 or more	36.2	20.2
Co-residing with children (%)	45.1	59.1
Co-residing with grandchildren under the age of 6 (%)	17.9	28.2
Observations	1272	1647

Source: CHARLS 2011/2012

Table 2: Estimation results

	Model 1		Model 2		Model 3	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
First stage estimates [Dependent variable: receiving pension benefits]						
Age > 60	0.370 ***	0.025	0.371 ***	0.025	0.368***	0.025
2SLS regression discontinuity estimates [Dependent variable: work status]						
Receiving pension benefits	-0.144 *	0.079	-0.132 *	0.074	-0.162 **	0.071
Age(centered)	-0.004	0.004	-0.002	0.003	-0.004	0.003
Age*above 60	-0.009	0.006	-0.003	0.006	-0.000	0.006
Female			-0.140 ***	0.016	-0.136 ***	0.015
Married			0.158 ***	0.028	0.138 ***	0.028
Functional limitation			-0.256 ***	0.025	-0.246 ***	0.024
Education						
Illiterate (reference)			ref		ref	
Elementary school or below			-0.010	0.018	0.011	0.018
Secondary school and above			-0.059***	0.022	-0.052 **	0.022
Having children under 16					0.162 ***	0.038
Number of adult children						
0					-0.121 **	0.053
1					0.024	0.023
2 (reference)					ref	
3					0.012	0.018
4					-0.046 *	0.026
5 or more					-0.061 *	0.034
Number of grandchildren under 16						
0					0.030	0.026
1					0.005	0.022
2 (reference)					ref	
3					-0.004	0.025

4 or more			0.038	0.024
Co-residing with children			-0.008	0.016
Co-residing with grandchildren under the age of 6			-0.023	0.018
Province dummies	No	No	Yes	
Observations	2919	2919	2919	

Notes: The estimates of control variables are omitted from the first stage regression. *** Indicate statistical significance at the 1% level; ** for the 5% level; * for 10% level

Source: CHARLS 2011/2012

Table 3: Income distribution

	Mean	Median	25th percentile	Observations
Total individual income	4,112	1,240	400	2,676
Total household income	20,545	10,500	2,770	2,811
Household income per capita	5,321	3,124	1,050	2,811
Total household expenditure	19,824	13,860	7,289	2,913
Household expenditure per capita	5,975	4,100	2,347	2,913

Source: CHARLS 2011/2012

Table 4: Robustness analysis, different age specifications

	Age 50-69 (±10)		Age 52-67 (±8)		Age 55-64 (±5)		Age 57-62 (±3)	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
2SLS regression discontinuity estimates [Dependent variable: work status]								
Specification of age: Linear	-0.162**	0.069	-0.221 ***	0.080	-0.207*	0.113	-0.253	0.202
Specification of age: Quadratic	-0.160**	0.071	-0.232 ***	0.084	-0.213*	0.117	-0.230	0.221
Specification of age: Linear spline	-0.162**	0.071	-0.234 ***	0.084	-0.214*	0.119	-0.235	0.228
Specification of age: Quadratic spline	-0.368**	0.150	-0.307 *	0.173	-0.393	0.311	-2.065	2.714
Observations	2919		2487		1664		1020	

Notes: *** Indicate statistical significance at the 1% level; ** for the 5% level; * for 10% level

Source: CHARLS 2011/2012

Table 5: Robustness analysis, falsification test

	Non NRSP sample		NRSP sample	
	Coefficient	Standard error	Coefficient	Standard error
Sharp regression discountinuity estimates				
Specification of age: Linear	-0.030	0.024	-0.061**	0.026
Specification of age: Quadratic	-0.028	0.024	-0.059**	0.026
Specification of age: Linear spline	-0.028	0.024	-0.060**	0.026
Specification of age: Quadratic spline	-0.015	0.034	-0.100***	0.039
Observations	3229		2919	

Notes: *** Indicate statistical significance at the 1% level; ** for the 5% level; * for 10% level
Source: CHARLS 2011/2012

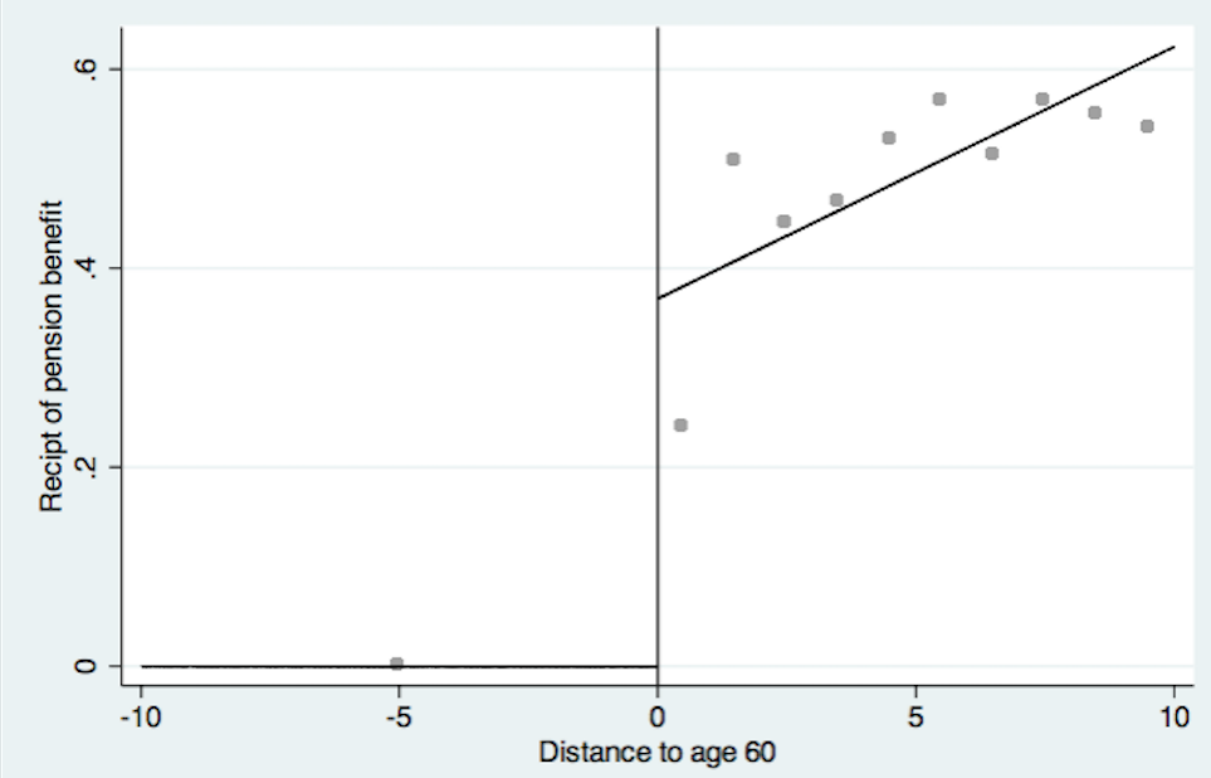
Table 6: Robustness analysis, placebo cutoff at age 59

	Discontinuity at age 59		Discontinuity at age 61	
	Coefficient	Standard error	Coefficient	Standard error
Sharp regression discontinuity estimates	-0.014	0.028	-0.044	0.029
2SLS regression discontinuity estimates	-0.069	0.134	-0.113	0.079
Observations	2919			

Notes: *** Indicate statistical significance at the 1% level; ** for the 5% level; * for 10% level
Source: CHARLS 2011/2012

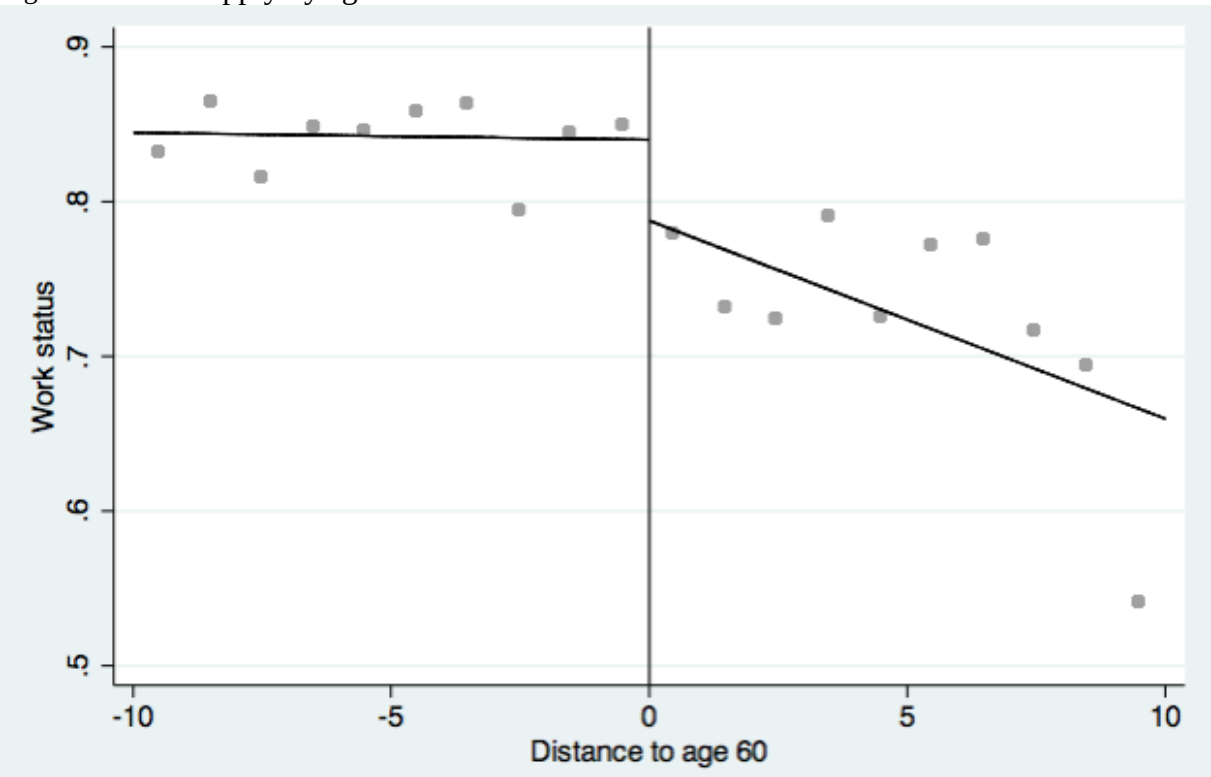
Figures

Figure 1: Probability of receiving pension benefits, by age



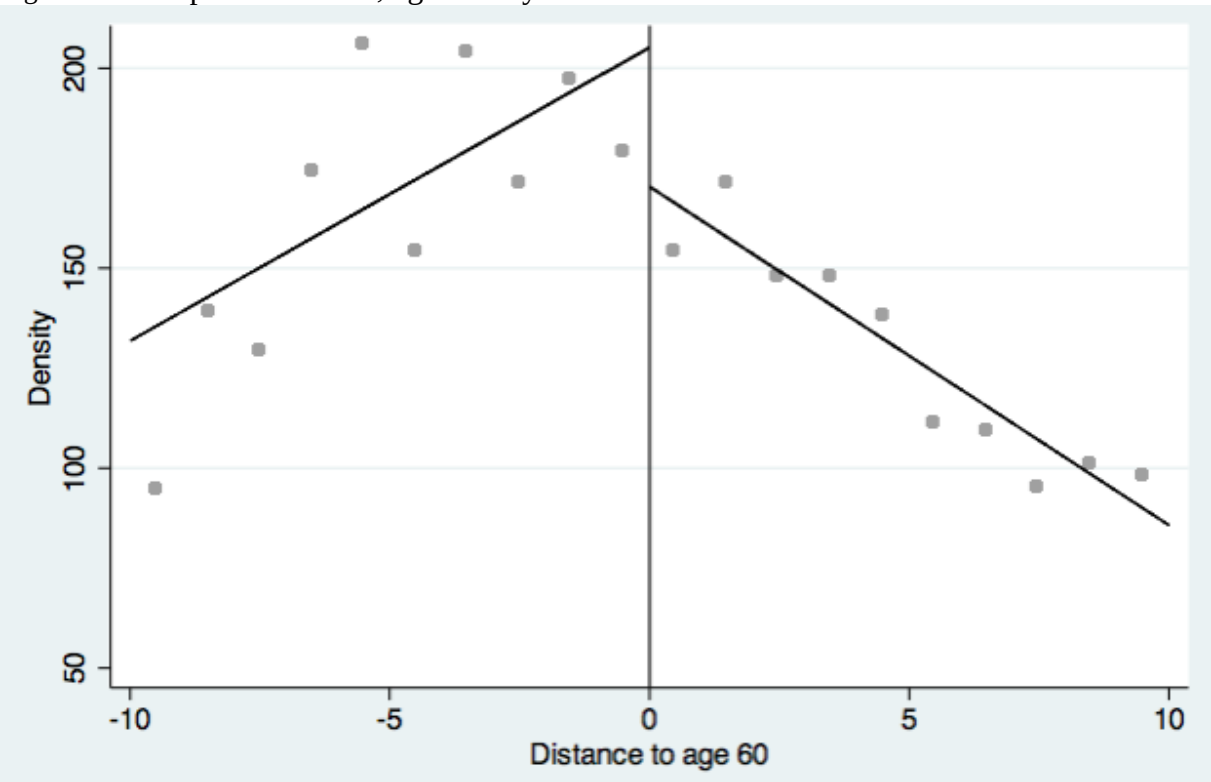
Note: Each dot represents percentage of respondents who receive pension benefits by each age group. The line is composed by the predicted values from a polynomial regression (of degree one).
Source: CHARLS 2011/2012

Figure 2: Labor supply by age:



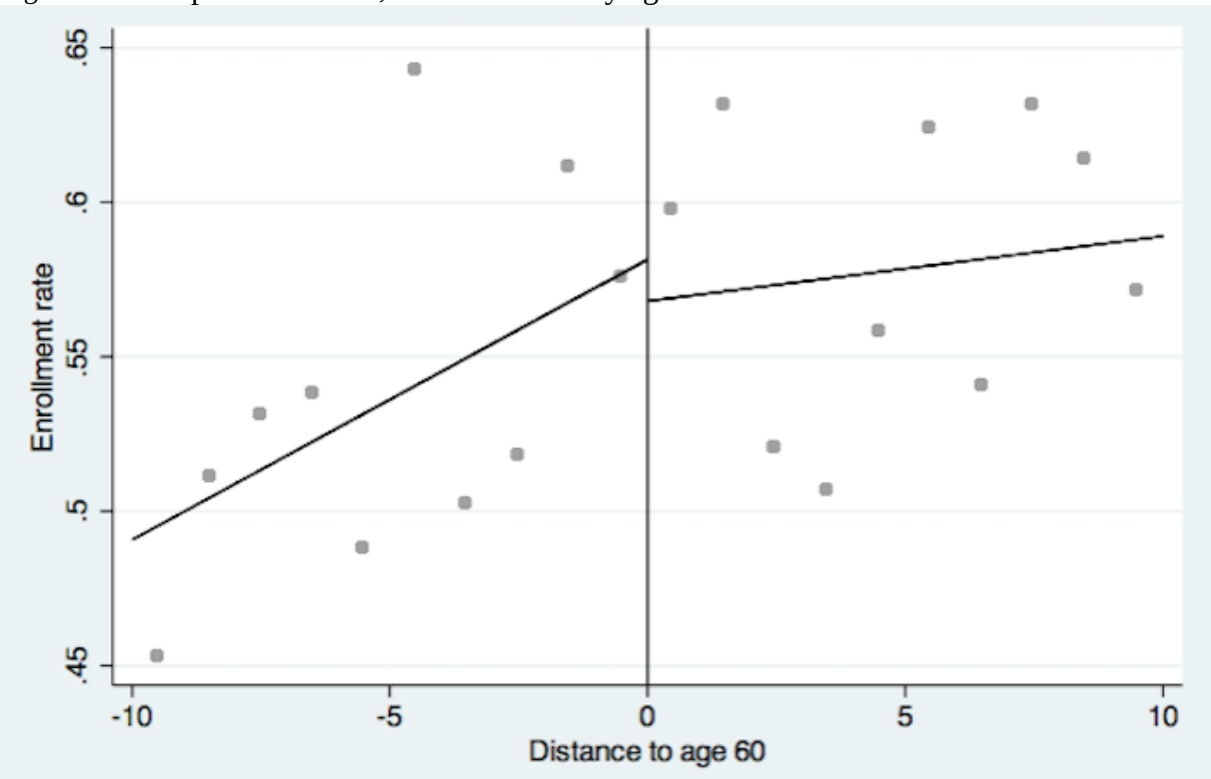
Note: Each dot represents percentage of respondents who are actively working by each age group. The line is composed by the predicted values from a polynomial regression (of degree one).
Source: CHARLS 2011/2012

Figure 3a: Manipulation check, age density distribution



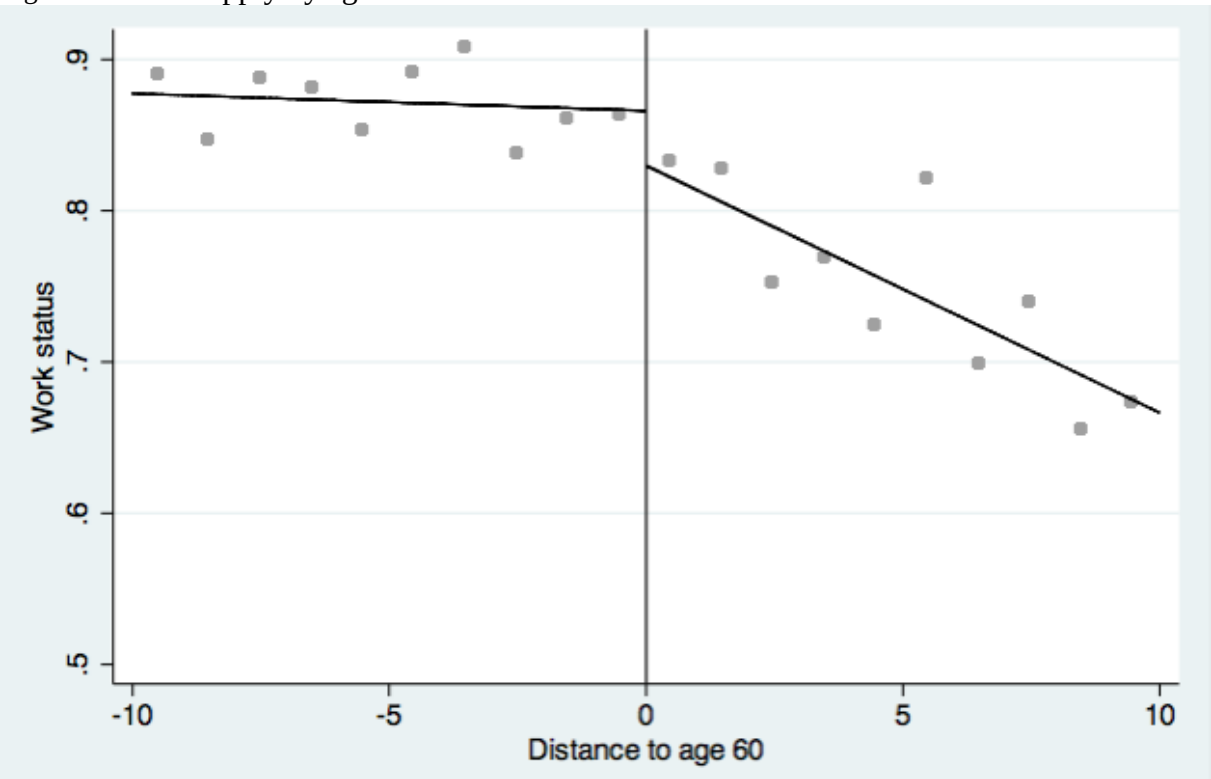
Note: Each dot represents number of respondents by each age group. The line is composed by the predicted values from a polynomial regression (of degree one).
Source: CHARLS 2011/2012

Figure 3b: Manipulation check, enrolment rate by age



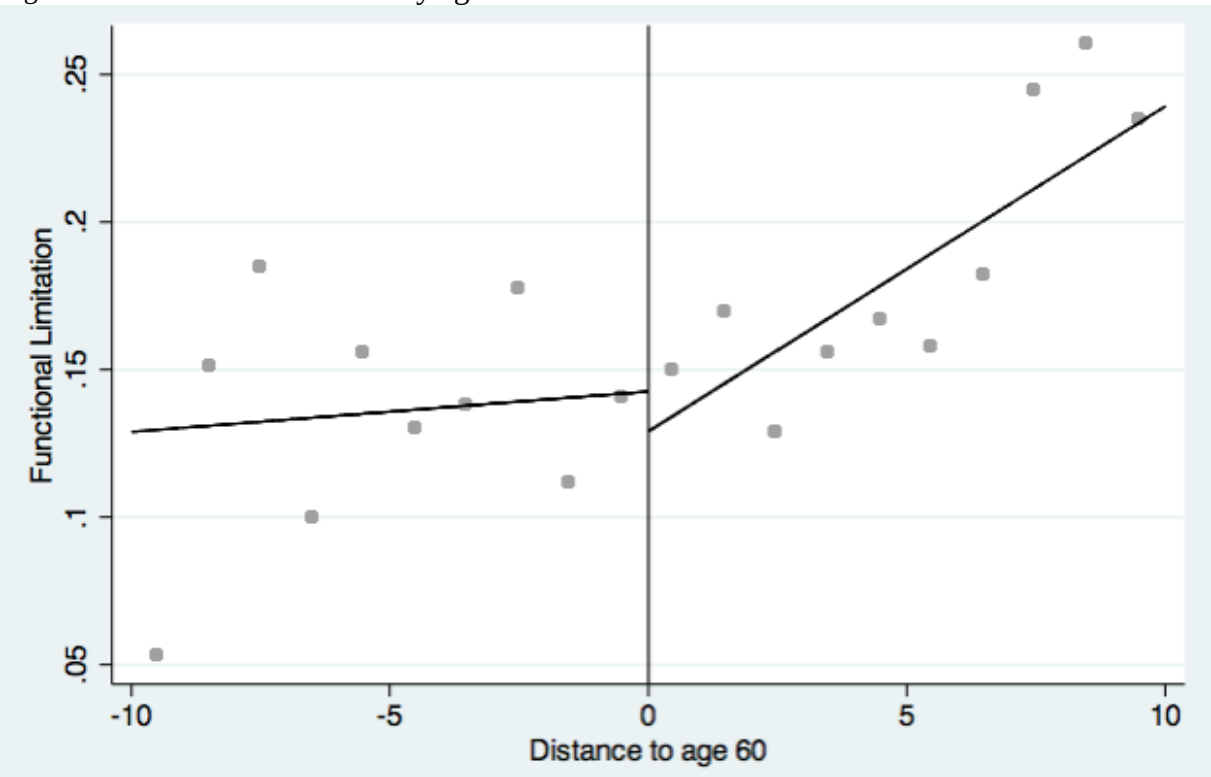
Note: Each dot represents the enrollment rate by each age group. The line is composed by the predicted values from a polynomial regression (of degree one).
Source: CHARLS 2011/2012

Figure 4: Labor supply by age in non NRSP areas



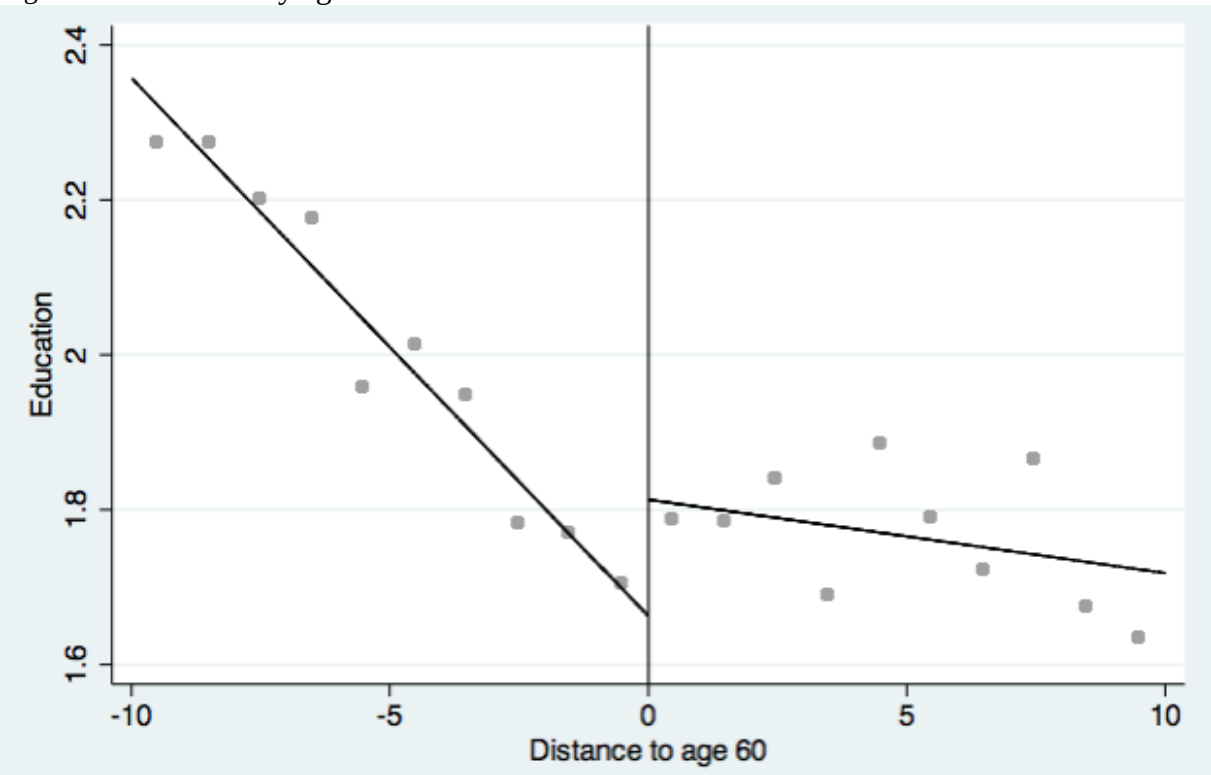
Note: Each dot represents percentage of respondents who are actively working by each age group. The line is composed by the predicted values from a polynomial regression (of degree one).
Source: CHARLS 2011/2012

Figure 5a: Functional limitation by age



Note: Each dot represents percentage of respondents who are functional limited. The line is composed by the predicted values from a polynomial regression (of degree one).
Source: CHARLS 2011/2012

Figure 5b: Education by age



Note: Each dot represents the average education level by each age group. The line is composed by the predicted values from a polynomial regression (of degree one).
Source: CHARLS 2011/2012

Appendix

Table A1: A schematic view of the implementation of NRSP

Year	Coverage	Participants
2009	The overall coverage is 10%. 320 counties participated in the pilot program.	15.38 million
2010	The overall coverage is 24%. 838 counties from 27 provinces are involved in the national polit. Additionally, 316 counties from 15 provinces initial NRSP pilot themselves. Beijing, Tianjin, Zhejiang, Jiangsu, Ningxia, Qinghai, Hainan and Xizang achieved full coverage.	103 million persons participated in the national pilot. Out of them 74.14 million are under age 60. The total participants are 143 million.
2011	The overall coverage is 60%. 1914 counties from 27 provinces are involved in the national polit. Additionally, 339 counties from 17 provinces initial NRSP pilot themselves.	326 million participants in the national pilot and 237 million are under age 60. The number of total participants is 358 million.
2012	Nationwide coverage for all 2853 counties.	460 million.