Social Insurance and Labor Supply in Rural China

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Abstract

This paper examines the effect of the New Rural Pension Scheme (NRPS) on labor supply among the aged population in rural China. Using a 'reversed' difference-in-difference specification, I find the introduction of NRPS has increased the (intensive) labor supply for both pensioners and contributors by more than ten percent. The heterogeneity analysis has suggested that the potential mechanisms are different for the pensioner and the contributor. For pensioners, the program has elevated effective labor productivity, through health improvement and credit constraint alleviation, which lead them to work more. On the other hand, the pension contributor, especially those who are hand-to-mouth, increases labor supply because the annual contribution is an additional financial burden to them.

1 Introduction

Since the start of the millennium, China has become an aging society. The percentage of the aged population (60+) has increased from 10.3% in 2000 to 17.3% in 2018 (National Bureau of Statistics, 2019).[1] Despite the tremendous economic boom since the market reform in 1978, the rural area has not benefited much compared to the urban counterpart (Chan, 2013). In particular, the urban society has established a comprehensive pension scheme since decades ago (Cheng et al., 2016), while the rural elderly mainly rely on their family members (Shi, 2006). However, such a family-support system has become in a shaky state due to shrinking family size and massive rural-to-urban migration of the younger generation (Ning et al., 2016).

In response to the great need, the Chinese government, in September 2009, introduced the new rural pension scheme (NRPS) that exclusively targeted to the rural population nationwide. The program, which was first implemented in 320 counties in 2009, expanded county-by-county to nationwide coverage by the end of 2012. The pensioner, aged 60 or above when the NRPS was covered, is entitled to receive a monthly payment of ¥55 regardless of the previous working history. The contributor, typically aged from 45 to 59, pays a voluntary annual contribution and receives a highly-subsidized pension when tuning 60. The NRPS is the most generous welfare program ever implemented in the rural area. According to Huang and Zhang (2016), by the end

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[1] China has a population of approximately 1.26 billion in 2000 and 1.42 billion in 2018.

of 2012, the government has spent ¥262 billion ($37 billion) on the program, and the figure has kept growing. Despite the importance of the program, policy-makers are often concerned about whether such a welfare program might discourage work.

Moreover, the effect of the pension scheme on labor supply is an understudied question in the development literature. Although the literature in the developed countries typically finds that pension decreases the labor supply (e.g., Ruhm, 1996; Börsch-Supan and Schnabel, 1998; Mastrobuoni, 2009), the findings in the developing countries are limited. This paper contributes to the literature by exploring the effect of NRPS on labor supply among the old rural workers in China.

Conceptually, the impact of the pension scheme on labor supply could go both directions, especially among the rural workers, who are typically low-income farmers. First, with additional non-labor income, one would consume more leisure, which leads to a decrease in labor supply. Second, poor, undernourished rural workers may not be productive at work. Additional income from social pension could help them eat better and improve health, which in turn will help earn more from each hour of work, thus lead to work more (Dasgupta and Ray, 1987). Third, rural workers usually have no access to credit. With a guaranteed (future) income stream, they will have better credit access. Therefore, they could have the opportunity to start a new business or expand the current one, which would also induce them to work more (Bianchi and Bobba, 2013). As a result, the effect of pension on labor supply is an empirical question.

This paper employs a *reversed* difference in difference (DiD) method to study the question, by exploiting the county-by-county rollout of NRPS expansion. The reversed method, described in detail below, helps overcome the issue that the pre-policy information is no available. The intuition of the method is the same as the standard DiD, while the identification is mainly from the *post*-policy parallel trend assumption. The main findings of the paper are as follows. First, the pension scheme has little impact on the extensive labor supply. It, however, increases the intensive labor supply (measured by weekly working hours) by 13.1 percent and 11.7 percent for the pensioner and the contributor, respectively. Second, the heterogeneity analysis has suggested that the mechanism through which pension affects the labor supply are different. For the pensioner, the impact is mainly due to the increase in labor productivity through health improvement and credit constraint alleviation. On the other hand, the contributor, especially the hand-to-mouth, increases labor supply because the pension contribution is an additional financial burden.

The rest of the paper organizes as follows. Section 2 reviews the related literature. Section 3 provides a detailed institutional background on NRPS. Section 4 presents a simple conceptual model to guide the empirical analysis. In Section 5, I describe the empirical strategy and data employed in this paper. Section 6 discusses the main empirical results, and Section 7 concludes.

2 Related Literature

This paper is related to three strands of literature. First, it contributes to the general literature on pension and labor supply. A common finding in the literature is that pension typically reduces labor supply among the older population, especially in developed countries (e.g., Ruhm, 1996; Börsch-Supan and Schnabel, 1998; Mastrobuoni, 2009). However, the literature is limited among developing countries due to data scarcity. The findings could vary significantly across countries due to different institutional, economic, and cultural settings (Todd and Wolpin, 2010). In particular, Banerjee et al. (2017) survey seven developing countries, and find social pension has little effect

on the labor supply of the aged. This paper contributes a new piece of international evidence in the literature under the context of the Chinese rural area, which resides around 20 percent of the world's rural population (World Bank, 2017). Besides, the findings in the developing countries exclusively focus on the labor supply effect on the pensioner, while this paper also explores the impact of social pension on the contributor's labor supply.

Second, it contributes to the literature on the evaluation of the NRPS on labor supply. Despite the importance of the program and the rural labor supply, there are very few works on this. To my best knowledge, the previous papers typically examine the cross-sectional evidence by comparing the participants and non-participants (e.g., Ning et al., 2016; Chen et al., 2015; Shu, 2018). For example, Ning et al. (2016) and Chen et al. (2015) use a regression-discontinuity design, by exploiting the sharp age-eligibility cut-off at 60, to examine the effect of NRPS (technically, the eligibility to receive pension) on labor supply. They find that there is a small negative effect of NRPS on the pensioner's probability of labor participation. Their design has a critical implicit assumption: the pension scheme does not affect the labor supply of the contributor. This paper uses a new empirical strategy that does not rely on such an assumption. It also allows me to examine the labor responses for both the pensioner and the contributor.

The third contribution is related to a small literature on the *reversed* DiD methodology. First, this method is particularly of interest in many developing countries, where the pre-policy data may not be available. For example, the survey data is still at a very early stage in many developing countries.[2] The reversed difference in difference specification could help circumvent the data scarcity issue on pre-NRPS period information by utilizing the post-policy period data. Second, this method has implicitly adopted in many papers (e.g., Pischke, 2007; Tricaud, 2019), but there is no explicit discussion on the formal proof until Kim and Lee (2018). Moreover, papers applying the reversed difference in difference method typically only address the key identification assumption - post-policy parallel trend assumption. There are, however, some additional critical assumptions that might also be implicitly involved.[3] This paper is among the first papers that explicitly discusses the inherent assumptions needed, and provides possible ways to examine the validity of the assumptions.

3 Institutional Background

3.1 Rural China

Although China had experienced rapid economic development since the market reform in 1978, the rural area does not benefit much compared to its urban counterpart. Table 1 shows a comparison between rural and urban areas in terms of infrastructure and public facilities. While the coverage of the facilities in urban communities is high, the rural area still lags far behind. For example, the main road is paved in only 59% of the villages; very few public bus lines pass the rural regions; the usage of tap water and gas for cooking is relatively low.

[2]For instance, Health Retirement Study (HRS) currently has nine international counterparts in developing countries. They all start in recent years (the first wave in parentheses) - Brazil (2015), Costa Rico (2005), India (2015), China (2011), Malaysia (forthcoming), Mexico (2001), South Africa (2015), Thailand (2015) - except Indonesia (1993).

[3]These additional assumptions, discussed in detail below, might hold under their settings, but the papers have not explicitly discussed them.

The rural labor market, especially for the aged population, is relatively simple — a majority of the rural workers involved in agricultural work. However, labor productivity is low. For one, the average literacy level is very low. According to CHARLS (2011), among the rural residents aged 45 and above, around 80 percent have no more than five years of schooling, and a vast majority have an education level lower than the middle school (eight years of education). Besides, the literature has well documented that many continue working even under poor health conditions or in old age (e.g., Cheng et al., 2016).

3.2 New Rural Pension Scheme (NRPS)

In line with the economic development, social welfare programs are typically developed separately for urban and rural residents. Since 1951, urban China has developed its first formal pension for the public sector. It sequentially extended to the private sector in the 1990s. The rural counterpart, on the other hand, had failed its first rural pension scheme, which was initiated in 1992 but terminated in 1999 due to various reasons. As a result, the rural elderly have mainly relied on their family supply (Shi, 2006). However, the family support mechanism has become shaky because of the recent massive out-migration of the youth as well as the shrinking family size. In response to the great need, the Chinese government initiated the New Rural Pension Scheme (NRPS) in 2009, and successfully covered the entire nation's rural area by the end of 2012. It was eight years faster than the initial completion year planned, 2020.

The program was gradually rolled out county by county.[4] In particular, if a local (county) government would like to implement the NRPS, it has to first apply to the provincial government for approval. Then, the provincial government would forward the potential candidates to the central government for a decision. The decision of the NRPS was entirely made by the central government, which could not be anticipated by the residents or even the local government. Although no official document has shown the mechanism through which the central government assigned NRPS, reports have indicated that the central government has intentionally balanced the rollout cross years. Table 2 lists a rich set of characteristics of the villages in counties that were covered by the NRPS in different waves, including basic demographic information, public facilities, and basic economic indicators. They look quite similar across waves.

3.3 NRPS enrollees

NRPS is only eligible for rural residents. In particular, the resident must hold an agricultural *hukou* (the registration system in Chinese), which is almost universal in the rural area. Also, it is practically impossible to convert from a non-agricultural *hukou*, which is prevailing in urban areas, to an agricultural *hukou*.

The initial pensioner, aged 60 or above at the time of NRPS introduction, is entitled to receive ¥660 (around $100) a year, which is paid monthly, regardless of his previous earnings or working experience.[5] The amount is around 1/3 of the national poverty line in 2009, or about 10% of the

[4] As a related note, there are around 2,850 county-level administrations in China. The average population size in each county is about half a million, of which, half live in the rural area.

[5] In the official guide from the central government, there is one additional requirement for the initial pensioner: his children, who do *not* have any pension plan, must also participate. However, this policy was poorly implemented in practice and had minimal binding effect. The enforcement of the requirement is infeasible according to an interview

average income per capita in rural areas (National Bureau of Statistics, 2011).

The initial contributor, aged between 45 and 60, pays a voluntary contribution of choice from $\{100, 200, 300, 400, 500\}$ every year before turning 60 or a maximal of 15 years' contribution. The pension is calculated based on the formula below.

$$p = \begin{cases} 660 + (c+30)\tau/11.58 & \text{if } \tau = 60 - \text{age} \\ 0 & \text{if } \tau < 60 - \text{age} \end{cases} \tag{1}$$

where the first term is the subsidy from the central government, and the second term is an individual retirement account (IRA). The IRA contains the annual contribution c, a local subsidy of ¥30, and the annuity discount rate 11.58. Besides, the interest rate is normalized to 0 for simplicity, and 11.58 is also equal to a conservative estimation of the life expectancy of rural residents at age 60 in 2009.[6] $\tau = 60 - age$ is years of contribution before turning 60, and *age* refers to the age when the pension scheme covers the county. Note that the contributor cannot claim the pension if their years of contribution are smaller than τ. For example, if a contributor was 55 years old when the NRPS was covered, he had to pay five years of contribution (e.g., ¥100) to get a pension at age 60. If he had paid less than five years, he would not be able to claim the pension at age 60.[7]

Although voluntary, the pension scheme is very financially attractive. Figure 1 shows the pension formula for a contributor who was 45 when the pension scheme was covered.[8] Even if he chose to pay the lowest contribution level, he would get ¥828 at age 60. The amount is more than half of the entire contribution ¥1500; in other words, it takes the new pensioner less than two years to break even. Given the average life expectancies at 45 and at 60 is around 32 and 17 years (Cai et al., 2017), respectively, even paying the lowest level of contribution is very financially appealing. On the other hand, it is less tempting to contribute more than ¥100 because every additional ¥100 (on top of paying the minimum) yields only an additional ¥8.6 in annual pension income (¥100 discounted by the annuity rate 11.58). If one is uncertain that his life expectancy is longer than 11.58, it would be a risky investment ex-ante.[9] Also, it might be more financially beneficial to use additional payment for other investments. Purchasing a buffalo, for instance, might generate more return than the pension contribution. As a result, among the participants, the vast majority of the contributors have chosen to contribute the lowest amount, ¥100.[10]

with a local officer at the Social Security Bureau. Primarily, the Bureau does not have access to registry information, so they could not identify the family member. Also, they could not check if the children have participated in any pension program (in other counties). Second, such a policy encourages the pensioners to cross-subsidize their children's pension contribution, which is not what the policymaker would hope to have. In fact, many places have waived this requirement shortly after the county was covered. In addition, my data have shown that having living parents has very little predictive power for the contributor to participate in NRPS, which suggests that the policy has a limited binding effect.

[6] According to Cai et al. (2017), the life expectancy of the rural residents at age 60 is 17 years in 2013.

[7] He might be able to claim the pension contribution back, but it would also involve non-trivial hustle costs.

[8] Appendix Figure 1 shows the pension formula for initial contributors at different ages when the pension scheme was covered.

[9] According to CHARLS (2011), among the sample younger than 60, more than half think they are likely to live to age 75. However, less than 20 percent of the sample is almost certain that they would live to age 75.

[10] The low contribution level might reflect some other primitives of the contributor. For example, rural residents might be short-sighted, or they are financially constrained. However, the study of explaining why the contribution level is universally low is beyond the scope of this paper. Instead, I take the fact as given.

4 Conceptual Model

This section provides a simple conceptual model to guide the empirical analysis in the following sections. In particular, a standard model prediction shows that pension reduces labor supply for both pensioners and contributors. However, when adding additional conditions, which shed light on the current institutional setting, alternative results raise.

For the pensioner. Assume the pensioner lives one period (from age 60 to the end of life). He chooses labor and consumption to maximize his one-period utility in the following form.[11]

$$\max\ u(c,l) = \log(c) + \log(H-l)\ \ s.t.\ c = a + p + wl$$

where c is the consumption; l is labor hours; H is the total hours; w is the wage; a is the initial saving; p is the pension received. A first-order-condition on l gives

$$l^* = \frac{H}{2} - \frac{a+p}{2w},$$

which is a decreasing function of the pension p. In other words, the model predicts that pension reduces the labor supply of the pensioner.

As mentioned above, the literature has suggested some additional insights into this model. The pension may increase labor productivity (w) through health improvement (Dasgupta and Ray, 1987) and credit constraint alleviation (Bianchi and Bobba, 2013). Let $w = \omega(p)$, where $\omega'(p) \geq 0$. Taking the derivative of l^* to p gives

$$\frac{\partial l^*}{\partial p} = \frac{(a+p)\omega'(p) - \omega(p)}{2\omega(p)^2},$$

where the sign of the numerator is indeterminate unless the values of parameters are explicitly given.[12] In other words, the effect of pension on the initial pensioner's labor supply could be ambiguous.

For the contributor. Assume the contributor lives two periods. At the beginning of the first period, the contributor decides the level of contribution e to the pension scheme.[13] He receives a pension $p(e)$ in the second period, where $p(e)$ refers to a simplified variation of the pension formula in Equation 1. That is,

$$p(e) = \begin{cases} 660 + (e+30)/11.58 & \text{if } e > 0 \\ 0 & \text{if } e = 0 \end{cases} \tag{2}$$

where a choice of $e = 0$ is equivalent to non-participation. During the two periods, he chooses optimal consumption and labor each period to maximize two-period utility in the following form.

$$\begin{aligned} \max U &= u(c_1,l_1) + u(c_2,l_2) \\ s.t.\ c_1 + e + a_2 &= a_1 + w_1 l_1 \\ c_2 &= a_2 + w_2 l_2 + p(e) \end{aligned}$$

[11] In the entire section, I have adopted the separable utility model for the sake of simplicity. The results are qualitatively similar if I use a flexible non-separable CRRA utility function.

[12] Note that if $\omega'(p) = 0$, the modified model goes back to the standard model described above.

[13] The notation is a bit different from Equation 1, but one could think e as the total contributions before the contributor turns age 60.

where $1,2$ are the index for the periods. The first-order condition on l_1 and a_2 gives the following interior solutions:[14]

$$l_1^* = \frac{H(3w_1 - w_2) - a_1 + e - p(e)}{4w_1}$$
$$a_2^* = \frac{a_1 - e - p(e) + H(w_1 - w_2)}{2}.$$

Plugging in l_1^* and a_2^* into the U and taking derivative of U with respect to e gives:

$$\frac{\partial U}{\partial e}\Big|_{e=0} = \frac{4(p'(e)-1)}{p(e) - e + a_1 + H(w_1 + w_2)}\Big|_{e=0} = \frac{4(p'(0)-1)}{a_1 + H(w_1 + w_2)} > 0,$$

since $p'(0) > 1$ according to Equation 2. Therefore, the contributor would always participate in the pension scheme. Moreover, the optimal labor supply l_1^* is a decreasing function of e, since $p'(e) > 1$.

$$\frac{\partial l_1^*}{\partial e} = \frac{1 - p'(e)}{4w_1} < 0.$$

In other words, the pension scheme decreases the labor supply of the contributor.

However, the above analysis implicitly assumes a complete credit market. The data, as discussed below, reveals that many contributors are hand-to-mouth with little assets in both periods (i.e., $a_1 = a_2 = 0$). In that case, the model would still suggest that the contributor prefer participating in the scheme, but the labor supply effect is different. As shown below, the optimal labor supply l_1^* now is an increasing function of e.

$$l_1^* = \frac{e + Hw_1}{2w_1}.$$

That is, the pension scheme could also increase the labor supply of the contributor if he is hand-to-mouth.

A brief discussion on an alternative model. The agent described above is a worker who optimally chooses labor supply and consumption. However, in theory, the agent can also be a firm since the vast majority of the workers are farmers, who could also be viewed as an individual enterprise (*Getihu* in Chinese). The firm chooses the optimal labor and capital to maximize production (or income). The labor is the same as the one described above, while the capital can be health capital as well as agricultural capital (e.g., tractor, water pump, and livestock, etc.). Every period, the firm optimally chooses the investment in health and agricultural capital, as well as the labor supply.

[14]The interior optimal solution can be achieved if there is no borrowing constraint.

5 Data and Empirical Strategy

5.1 Information on the NRPS assignment

The information on when the NRPS covered a specific county is *not* publicly available, except for the first 320 counties in 2009.[15] Even if such information were collected, survey data usually do not reveal the county names due to the Chinese privacy law, making it infeasible to link to the survey and county names. To identify when a specific county was assigned NRPS, I have to rely on surveys that contain information on NRPS. It leaves me with two national representative databases - China Health and Retirement Longitudinal Study (CHARLS) and China Family Panel Studies (CFPS).[16] These surveys, conducted biennially, from 2011 and 2012, respectively.

Both surveys have asked the interviewees month and year he *started* to participate in the NRPS. As the procedure is analogous in CFPS, I use CHARLS to explain in detail how I define the year when the NRPS covers a particular county. There are 150 sampled counties; each county contains two villages on average; around 50 people were surveyed in each village. First, I check through all the answers within each village. I use the month and year that *most* respondents have replied as the time when the program covered the village. A nice observation is that most interviewees report the same answer in the same village, which enhances the reliability of this exercise. Second, I collapse the data into the village level and look at the month and year within a county. The villages within a county typically have a slightly different starting month, but the year is the same.[17] I use that year as the year when the NRPS introduced to the county. Finally, I have found that 12.0% of counties were covered in 2009, 19.3% in 2010, 38.6% in 2011, and the rest in 2012. The figures are very similar to the official statistics, where 11.2%, 15.7%, 37.6% of counties in 2009, 2010, 2011, respectively.

5.2 The reversed difference in difference strategy

As mentioned in Section 3, the program was rolled out on a county-by-county basis, and the arrival of NRPS was exogenous to the rural resident. The difference in difference (DiD) method could be applied to estimate the effect of the pension scheme on the treated counties (compared to the control counties). The technique requires pre-policy period information to examine the central identification assumption: pre-policy parallel trend. However, the earliest available year of the data is 2011, which is in the middle of the policy expansion.

To circumvent this issue, I have modified the standard DiD by adding a twist. That is, I study

[15] I applied to request such information a few months ago from the State Council Leading Group Office of Poverty Alleviation and Development, which published the names of the 320 counties in 2009. No reply, however, has been given. One alternative yet impractical way is to obtain such information is to collect NRPS related news from thousands of local newspapers in the 2,851 counties.

[16] The two surveys are the Chinese versions of the Health and Retirement Survey (HRS) and Panel Study of Income Dynamics (PSID), respectively. To my best knowledge, several smaller-scale projects survey information on NRPS (e.g., Chen, 2017; Chang et al., 2014). However, they all use proprietary data.

[17] A small number of villages reported years before 2009. These might be the pilot villages before the central government officially launched the NRPS. According to the official documents, a good number of villages have participated in the pilot programs, and most of them are in the initially assigned counties in 2009. Therefore, I treat their participation year as 2009.

the effect of the program expansion on the *control* counties (compared to the treated counties).[18] To be more specific, counties that were treated in 2009 and 2010 were already treated in 2011; as the policy expanded, the control (or untreated) counties would be covered by the end of 2012, while the previously treated counties remain treated. In the standard DiD jargon, the already treated counties were the control group, and the counties that switch their treatment status are the treated group. Therefore, the notions are reversed, and the method is called a reversed DiD. Kim and Lee (2018) have shown that, in contrast to the standard DiD, the identification of the reversed DiD comes from the post-policy parallel trend assumption. This paper also discusses additional assumptions in detail below.

Figure 3 demonstrates a visual representation of the reversed DiD method. The blue points and the green points are, respectively, the control (to-be-treated) counties and the treated (already-treated) counties. Given the parallel post-policy period trend assumption holds, the average treatment effect on the control is the red line segment, and the effect is positive. The intuition is that if the control group was treated in 2011, they should have been in the parallel position of the green point.[19] Therefore, the effect could be identified using the four points, i.e., the average labor supply in both control and treated counties in the years 2011 and 2013.

Moreover, one could also use the regression model, which accounts for the covariates, to reduce bias and improve precision. The specification is as presented in Equation 3, which is the same for the standard DiD.

$$y_{it} = \alpha + \beta T_{q(i)t} + \delta t + X_{it}\gamma + \theta_i + \varepsilon_{it}, \tag{3}$$

$$T_{qt} = \begin{cases} 0 & \text{if } q = 0 \\ 0 & \text{if } q = 1, t = 0 \\ 1 & \text{if } q = 1, t = 1 \end{cases}$$

where y is the outcome variable; θ_i is the individual fixed effect; ε is the error term. X is time-varying individual characteristics, including marital status, the number of children, and age dummies. t is a time dummy which is equal to zero if year equals 2011, and one if the year is 2013. The main difference to the standard DiD is the variable q. It is a dummy, which equals to zero if the treatment status remains treated in both periods, and is one if the status switches from control to treated. The coefficient β on T_{qt} is the reversed DiD coefficient. The standard errors are clustered at the county level, following Bertrand et al. (2004).

Identification assumptions

Apart from the post-policy parallel trend assumption, three additional assumptions are worth discussions under the current institutional setting.

Forward-looking behavior. If the rural workers in the control counties could anticipate the program coming in 2012, they might start to adjust their labor supply before the program arrived. Such behavior not only undermines the assumption that the coverage of the NRPS is exogenous, but also

[18] In the language of Angrist and Pischke (2008), the standard DiD examines the average treatment effect on the treated (ATT), while the reversed DiD explores the average treatment effect on the control (ATC).

[19] Appendix Figure 2 shows the analogous visual representation of the standard DiD.

could lead to a biased estimate. However, under the current setting, the introduction of the pension scheme is very likely to be exogenous. First, the central government initially planned to achieve nationwide coverage by the end of 2020 instead of 2012. If the rural workers were anticipating, they would have to expect at least eight years ahead. Second, because of the low education level, rural residents usually receive specific policy information from the village leader, while the village leader receives information directly from the county government. Long-run anticipating behavior is not common in rural areas. Moreover, due to the failure of the old pension scheme, the rural workers, especially the aged, have a very low level of confidence in the successful implementation of the NRPS (Cheng et al., 2016).

Constant treatment. While the initial pensioners receive the same treatment of ¥660 annually, the initial contributors are subject to (potential) heterogeneous treatments. In particular, the contributor receives two distinct treatments: the annual contribution of choice (typically ¥100), as well as the pension (more than ¥660) they would receive at age 60 and onward. The latter is the primary treatment, but it is different for counties treated in different years. Suppose, for insurance, Mei and Long were both 45 in 2009. The NRPS covered Mei and Long's counties in 2009 and 2012, respectively. Given they pay ¥100 annually, Mei and Long would expect to get ¥828 and ¥805 at age 60, respectively. Therefore, the expected pensions were very close in practice, with less than a 3% difference.

To mitigate the concern further, I also use different treatments for different contributors instead of the current binary (constant) treatment, as a robustness check. That is, I use the expected pension received for each contributor by assuming everyone would pay the lowest level. For example, I use ¥828 and ¥805 as the different treatments for Mei and Long, respectively. Appendix Table 1 shows the results qualitatively similar to the ones in Table 7. The magnitudes in Appendix Table 1 suggest that there is little effect of the expected pension on the extensive labor supply, while every ¥100 in the expected pension would increase the weekly working hour by 0.66 hours or 1.6 percent. A back of envelope calculation shows that a ¥23 difference in the expected pension could only increase the labor supply by 0.15 hours, which is only a 3% difference in the magnitude of effect in Table 7.

Time-accumulative effect. The reversed DiD strategy implicitly assumes that there is no time-accumulative effect. It means that the treatment effect would be the same on those treated for a more extended period and on those treated for a shorter period. If there were such a difference, one could expect to have two very distinct results if I estimate the following two subsamples separately: (i) counties treated in 2009 and 2012; and (ii) counties treated in 2010 and 2012. However, as shown in Appendix Table 2, the estimates are very similar across the subsamples. Besides, the estimates are similar to those in Table 5.

5.3 Final sample

This paper mainly uses the panel data in 2011 and 2013 of CHARLS for the empirical analysis in Section 6. The sample is restricted to rural villages, and all *yuan* (¥) amounts are converted to 2011

yuan using the CPI. Besides, the final sample excluded the counties that were treated in 2011.[20] Because those counties in CHARLS 2011 might belong to either the already treated counties or the control counties since the date when the village was surveyed is unknown. Moreover, I have defined the initial pensioner and the initial contributor as follows.

- The initial pensioner is defined if he was 60 at the time when the NRPS covered his county. Therefore, in the year 2011, the youngest pensioner was 62 and 61 years old if his county was covered in 2009 and 2010, respectively.

- The initial contributor is defined if he was at least 45 at the time when the program was introduced. Again, the youngest contributor was 47 and 46 years old if the NRPS introduced to his county in 2009 and 2010, respectively. Moreover, he had to be younger than 60 in 2013, so that he remained as a contributor in both periods. This paper does not include the contributor who changes from a contributor to a pensioner during the sample period. For example, if a contributor was 59 in 2011, and he would become a pensioner in 2013, then he would not be in my sample. Although it would be interesting to study this subgroup separately, I do not have enough observations to do so.

Last but not least, to check the post-policy parallel trend assumption, I use cross-sectional data in CFPS (2014), CHARLS (2015), and CFPS (2016). A natural question to ask is whether CFPS and CHARLS are comparable. First, both databases are administrated by Peking University. The survey teams were recruited and trained in a similar way. Second, since the two surveys are both national representative, the counties treated in each wave should look similar in both samples. For example, among 320 counties treated in 2009, 19 were sampled in CFPS, and 18 were sampled in CHARLS. As shown in Table 3, the counties covered in different NRPS waves are very similar between CHARLS and CFPS.

Table 4 presents some basic characteristics of the sample. First, the labor supply is high in the sample. The majority of the contributors are working, and more than half of the pensioners are also working. Also, the average schooling is very low. The average education level of the contributors is five years (a primary-school graduate), while the average year of school among pensioners is smaller than three years. On average, the pensioners have more than three children, while the contributors have around two children.[21] The self-reported health status is not satisfactory, as the percentage of residents who report as in poor or fair health is high.[22] Finally, the asset level is very low, which indicates that many of them might be hand-to-mouth workers.

[20] In the earlier draft of the paper, I have included those counties, by utilizing the fact that CHARLS usually finishes most of the survey process by the end of August. In particular, I used counties treated after August as the control, and the rest as the previously treated. The results are very similar.

[21] As a side note, some of the (younger) contributors are affected by the one-child policy. In many rural areas, the policy allows a couple to have another child if the first is a girl.

[22] The questionnaire asks the interviewees to choose from the following five categories: poor, fair, good, very good, and excellent. Around 25 percent and 35 percent reported as in poor health conditions among the contributors and the pensioners, respectively.

6 Empirical Results

This section presents the main empirical results. First, I discuss the effect of NRPS on its participation rate. Second, I explore the impact of NRPS on the labor supply of both pensioners and contributors, as well as some heterogeneity analyses.

6.1 NRPS participation rate

Figure 4 plots the participation rate of the contributor and the pensioner before and after the nationwide expansion of NRPS. Before the expansion, there was no participation in the control counties, while the treated counties already have a relatively high level of the participation rate. After expansion, the participation rate in control counties went up to a similar level of the treated counties. The participation rate stays at a similar level for both control and treated counties afterward.[23] This figure illustrates clear evidence that the rural residents respond and participate in the NRPS shortly after the introduction of the program.[24]

The overall participation rate was around 70.1 percent and 66.6 percent for the pensioner and contributor in 2013, respectively. The figures are similar to the official statistics 68.9 percent and 67.0 percent.[25] Besides, Chang et al. (2014) conducted an independent but smaller-scale national representative in 2013. They found the overall participation rate is 73.9 percent, which is also similar to the rate calculated by CHARLS (2013).

One interesting observation here is that the participation rate is not even near 100 percent, although the program is financially appealing to participate. However, the participation rate is comparable to its international counterparts. For example, South Africa implemented a more generous pension scheme than NRPS in 1993, while the take-up rate was roughly 80 percent (Case, 2005).[26] Moreover, the non-participation may be due to information. CHARLS (2013) has asked the interviewees the reasons why they do not participate. The replies have implied that they might not understand or do not know the program.[27] Since the take-up rate is not universal, this paper estimates the *intent to treat on the control*.

[23] There is also a slight increase in the already treated counties from 2011 to 2013. I think it could be primarily due to a redesign of the questionnaire in 2013. In particular, in the 2013 survey, there are a series of social pension-related questions before asking "Do you participate in the NRPS?", while in the 2011 study, such a question is asked immediately after a series of questions about the commercial pension. There could be a group of residents who do not know the NRPS is the program they have participated in, partially due to the linguistic variation in China and the low education level among the rural residents. Therefore, the interviewees in the 2013 survey would be more likely to realize the NRPS is the program they have participated in.

[24] A common concern in the pension literature, especially among developing countries, is that public pension might crowd out the family supports (e.g., Albarran and Attanasio, 2003), which typically include coresidence and private transfers. Appendix Table 3 shows that the NRPS does not affect the pensioner's living arrangement. Also, it crowds out less than ¥200 on average, which only accounts for a relatively small portion of the pension received.

[25] To be more precise, these figures are the author's calculation based on two official sources: (i) population by ages from National Bureau Statistics (2013), and (ii) the number of pension participants reported in Statistic Bulletin on Human Resources and Social Security Development (2013).

[26] It would be interesting to see why the South Africans do not have a universal take-up rate, but the author did not mention it in the paper.

[27] Such answers include: (i) the scheme has not introduced to my county; (ii) the pension scheme is not financially beneficial. However, the nationwide coverage finished by the end of 2012. Also, the pension scheme is indeed economically attractive, as discussed in Section 3.

6.2 Labor supply of the initial pensioner

As mentioned in Section 4, the theoretical prediction of the effect under a standard labor supply model is negative, but the outcome could also be ambiguous under the current setting. Figure 5 exhibits the impact of NRPS on the labor supply of the initial pensioner (60+). The top panel demonstrates that the introduction of NRPS has little effect on the extensive labor supply, measured by the probability of working. Following Banerjee et al. (2017), I also explore the impact on intensive labor supply, measured by weekly working hours.[28] Intensive labor supply is an essential measure in rural China. Like many developing countries, most of the workers in rural China involve in farming, so they can adjust the working schedules in a flexible way, such as choosing different crops and a different size of agricultural land. The bottom panel of Figure 5 illustrates that the NPRS has *increased* the weekly working hours by 4.6 hours or 13 percent, and the effect is statistically significant.[29]

Table 5 shows the regression estimates using Equation 3. Columns 1 and 3 present the same estimates as Figure 5. Columns 2 and 4 indicate that the estimates are robust after controlling time-varying covariates, cohort fixed effects, and individual fixed effects. Since the intensive working hour is conditional on working, it would also be interesting to explore the unconditional working hours by defining zero working hour as non-working. The last two columns in Table 5 suggest that the effect on the unconditional working hours is still substantial, with around 12% increase, and the estimates are marginally statistically significant (with t-statistic $= 1.60$).

Heterogeneous effects on the initial pensioner

To provide evidence on the mechanisms through which the NRPS affects the labor supply of the initial pensioner, I explore the source of heterogeneity in Table 6. First, it is straightforward to think that the effect of NRPS might be different for different age groups (below and above age 70). Panel A of Table 6 shows that the overall effects of the younger pensioners are larger and statistically significant. However, the point estimate of the intensive labor supply of the older pensioners who are working is also relatively large (although not statistically significant). It suggests that there could be alternative channels that affect the labor supply differently. In particular, I follow the discussion in Section 4 by exploring the two critical channels in the literature: health and credit constraint.

[28] Since the raw survey data involves some unreasonably high reported weekly working hours (e.g., 168 hours), I have top-coded the hours at 84 (98th percentile). The choice of 84 is because the original survey question also asked the interviewer to double-check if the number is no more than 84. The results are very similar if I drop the outliers or use the original values.

[29] At first glance, the (small) gap between the control and the treat in the post-parallel trend might seem to contradict the fact that the central government has tried to balance the rollout. I would address the concern in two directions. First, the central government's choice is based on the characteristics of the counties, but the pensioner per se. So the balanced rollout at the county level does not necessarily mean it is balanced in the pensioner. In fact, if I zoom out the graph in Appendix Figure 3, the two trends are very close. Also, the results in the contributor's labor supply (in Figure 6), as well as the participation rate (in Figure 4) have suggested that the rollout was quite balanced. Second, even if the initial rollout was balanced for the pensioners in different waves, it is not a guarantee they respond to the policy in the same way. In other words, a small disparity in the post-policy period does not necessarily reflect the imbalanced assignment before the policy.

Health improvement. The literature has suggested that social pension in developing countries could help the pensioner improve health (e.g., Case, 2005; Cheng et al., 2016). A health improvement not only is vital in physical work but also enhances productivity at work (Dasgupta and Ray, 1987; Baird et al., 2018). In particular, Cheng et al. (2016) find that the additional income from the NRPS has benefited the pensioner by having higher protein and nutrition intake.[30] To explore the heterogeneous effect in the initial health condition, I have created two subsamples. The first subsample reports their initial health condition as fair or poor, while the second subsample reports good, very good, or excellent.[31] Panel B of Table 6 shows that the effect of the pension scheme is large and statistically significant on those with a poor initial health condition, while its impact on the healthy subgroup is minimal.

To future explore the potential mechanisms on how the NRPS could affect health, I have investigated the relationship between the pension scheme and different health measures in Appendix Table 4. Columns 1 and 2 show, respectively, the NRPS has limited (short-term) effect on the self-reported overall health status and the self-reported daily functional difficulties (e.g., difficulty in walking or jogging for one kilometer). Column 3 shows that the introduction of the NRPS is associated with an increase in the *objectively* measured body mass index (BMI) by 1.2%, and the estimate is statistically significant.[32] The magnitude corresponds to an average of one-kilogram weight gain, which is critical for physical work such as farming.

Credit constraint alleviation. Another important channel suggested by the literature is that social pension could alleviate the pensioner's credit constraint (e.g., Ardington et al., 2009). In rural China, credit access is limited. According to the village survey in CHARLS (2011), less than 10% of the village households have loans from formal financial institutions. The guaranteed income stream from the social pension could help the old ameliorate their credit constraint, thus expand business (mainly farming). To explore this aspect of heterogeneity, I break the sample into two based on whether the pensioner has a below- or above-median asset level. Panel C of Table 6 shows that the impact of the NRPS is substantial on the pensioners with below-median assets, while the effect is minimal and statistically insignificant on those with above-median assets.

The results suggest that pension might have helped the pensioner alleviate the credit constraint. To further provide evidence on this channel, I have explored the association between the pension scheme and different measures of agricultural assets in Appendix Table 4. Column 4 indicates that the pension scheme has induced them to use more land by 0.4 acres, on average.[33] Columns 5 and 6 show that the pension scheme has helped the pensioner substantially increased in the agricul-

[30] In rural China, protein-rich food, such as lean meat and seafood, is much more expensive than vegetables and fruits in general.

[31] Due to the reverse nature of the empirical strategy, the initial condition is somewhat cumbersome to define. Since the self-reported health status stays steady over the two periods, the initial condition is similar in both periods. Therefore, I have used the health condition in 2013 as the "initial" health condition, and the result remains the same. Since the health status is an endogenous variable, the initial condition from 2011 is still preferred.

[32] The interviewers conducted the on-site measure of BMI (= weight/height2) during the survey. Underweight is a critical issue in rural China due to a lack of nutrition intake. It has proved to be associated with poorer health, higher mortality rate, and lower cognitive abilities (Selvamani and Singh, 2018).

[33] As a related note, there are various ways land can be acquired. First, not every household has utilized the original land size, which is granted by the government (for free). Second, one could get approval from the government for the reclamation of uncultivated land. Besides, one could rent from other rural residents who have not used their entire land.

tural fixed capital (e.g., tractor, water pump, and processing equipment) as well as the agricultural livestock, by around ¥242 and ¥318, respectively.

6.3 Labor supply of the initial contributors

The theoretical prediction in Section 4 shows that a generous pension scheme would lead to a decrease in the contributor's labor supply in a complete market. However, if the contributor is hand-to-mouth, the effect could go the other direction. The top panel of Figure 6 exhibits that the NRPS has a small and statistically insignificant impact on the extensive labor supply, measured by the probability of working. In the bottom panel of Figure 6, it indicates that the introduction of NRPS has *increased* the intensive labor supply, measured by the weekly working hours, by 4.76 hours or 11 percent.

Table 7 shows the regression estimates using Equation 3. Columns 1 and 3 present the same estimates as Figure 6. Columns 2 and 4 show that the estimates are robust after controlling time-varying covariates, cohort fixed effects, and individual fixed effects. The last two columns suggest that the effect of the pension scheme has also substantially increased the unconditional working hours by 4.77 hours or around 13 percent.

Heterogeneous effects on the initial contributor

As mentioned above, the theoretical model suggests that the impact of the pension scheme could increase the contributor's labor supply if he is hand-to-mouth. To further explore this mechanism, I have divided the sample into two based on the median financial non-housing asset. Since the median is only ¥500, the below-median contributors are approximately hand-to-mouth. Panel A of Table 8 shows that the results diverge for the two subsamples. For the below-median contributor, the effect of the pension scheme is substantial and positive. The estimates are also larger than the overall effects in Table 7. On the other hand, the impact on the above-median contributor is negative, although the estimates are small and statistically insignificant.[34] The results imply that the pension scheme might have introduced an additional financial burden to the hand-to-mouth contributor. As a result, they would have to work harder to participate.[35]

However, why would the contributor increase their labor supply substantially for a relatively small contribution level of ¥100? One straightforward reason would be that the contributor could not perfectly adjust their labor supply. For example, one might provide manual labor in other farmer's land to acquire additional income, but it is unlikely he could choose to work precisely half an hour every week. Another subtle reason is that once the contributor decides to participate in the pension scheme, he would have to commit the payment for the entire years before he turns age 60. Therefore, the younger initial contributors should be affected by the pension scheme more than the older ones. Panel B of Table 8 provides the evidence. The effects are large and statistically significant for the younger contributors (aged 45 - 54), while the pension scheme has little impact on the older ones (aged 55 - 59).

[34] As a robustness check, I break the sample according to the median non-housing non-financial asset (¥728), the effects are very similar (see Appendix Table 5).

[35] One might argue that they could choose not to participate if contribution since the scheme is voluntary. However, Section 3 shows that the pension formula is very financially appealing. Because one could get a very generous pension at age 60 by paying the minimum contribution level.

7 Conclusion

Due to the massive out-migration of the rural young workers and shrinking family size, the growing old population in rural areas has been of great importance to the policymakers in China. From 2009 to 2012, China introduced the New Rural Pension Scheme, which is the most extensive rural welfare program in history, to the rural areas nationwide. This paper explores the effect of the pension scheme on the labor supply of the old workers, which is an understudied question in the development literature.

Using a reversed DiD methodology, I find that the NRPS has little effect on the extensive labor supply, but has increased the intensive labor supply by more than 10 percent. The heterogeneity analysis suggests that the channels through which the pension affects labor supply might be different for the initial pensioner and the initial contributor. For the pensioner, the NRPS is associated with health improvement and credit constraint alleviation. The contributor, especially those who are hand-to-mouth, works more because the pension scheme might have introduced an additional financial burden. From a welfare point of view, an increase in the labor supply of the pensioner may be indeed welfare improving. The extra income has helped them enhance effective labor productivity through health improvement and credit constraint alleviation. On the other hand, the pension scheme might have hampered the contributor, although it would eventually help when he becomes a pensioner. As the DiD method studies a short-term impact of the program, the long-run effect might be quite different, which would leave for future research.

Moreover, this paper has implied a few interesting policy implications of the NRPS. First, the design of the pension formula seems to discourage people from contributing more than the minimal level. Instead of using a flat *local* subsidy, a higher local subsidy for a higher contribution level might help incentivize the contributor to contribute more. In fact, some prosperous provinces have recently adopted such a policy. Second, the pension scheme seems to have little impact on the wealthier rural residents. An alternative policy of the universal pension scheme might be a means-tested welfare program to help the poor. However, such a means-tested program might discourage the labor supply of marginal workers. Therefore, the exact trade-off needs a rigorous examination, which would call for a structural model. An extension of the models discussed in Section 4 could serve a good starting point of the structural estimation as the future development of the paper.

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Figures and Tables

Table 1: A comparison between rural and urban China

	Rural village	Urban community
the main road is paved	0.59	0.95
number of public bus lines accessible	1.33	5.03
distance to the nearest train station (km)	35.10	15.64
main cooking water is tap water	0.41	0.92
main cooking fuel is petroleum or natural gas	0.28	0.74
a central heating system is established	0.01	0.35
there is any sewer system	0.16	0.87
mainly use an indoor toilet	0.31	0.80
there is a kindergarten	0.43	0.79
there is a nursing home	0.08	0.23

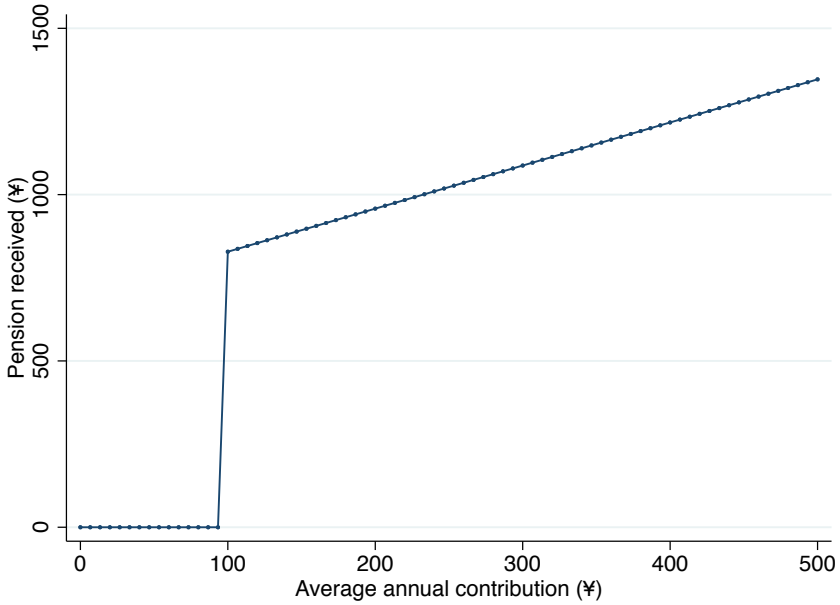
Notes: The table bases on an independent community/village survey by asking only the village/community officers, conducted by CHARLS (2011).

Table 2: The characteristics of the counties treated in different waves

NRPS covered year	2009	2010	2011	2012
Basic conditions				
Fraction of agricultural land	0.72	0.74	0.71	0.65
Whether a natural disaster in past 5 years	0.45	0.42	0.38	0.43
Fraction of population aged 60+	0.19	0.20	0.23	0.22
Fraction of adults who finished primary school only	0.32	0.27	0.32	0.31
Infrastructure and public facilities				
Fraction of villages that have paved roads	0.62	0.64	0.55	0.53
Whether tap water is accessible	0.40	0.46	0.49	0.50
Whether central heating system is established	0.02	0.00	0.01	0.02
Whether public toilet is available	0.26	0.26	0.28	0.30
Fraction of villages that have an accessible public bus line	0.52	0.45	0.56	0.50
Economic conditions				
Average monthly wage of a male in a local firm (in ¥1,000)	1.56	1.62	1.59	1.57
Average monthly wage of a female in a local firm (in ¥1,000)	1.27	1.33	1.29	1.21
Average daily wage for manual male labor (¥)	73.4	75.2	75.3	72.8
Average daily wage for manual female labor (¥)	54.6	58.2	57.2	54.2
Average pork price (¥/500g)	14.35	13.35	13.88	13.73
Average egg price (¥/500g)	6.19	6.27	6.07	6.13

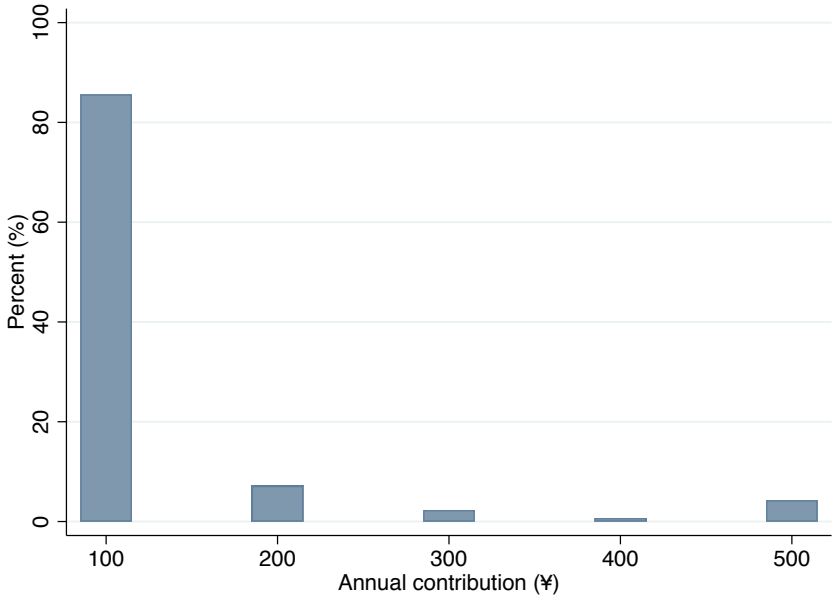
Notes: The table bases on a village-level survey conducted by CHARLS in 2011, which asks the village leaders only.

Figure 1: Pension formula for the contributors



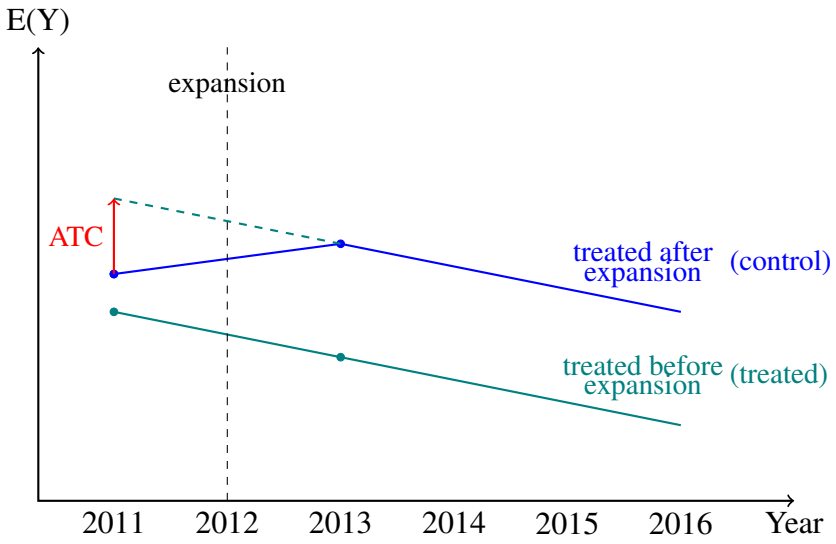
Notes: Assume the contributors pay the same annual contribution for 15 years. The graph plots the corresponding pension received after age 60.

Figure 2: Distribution of annual contributions in 2013



Notes: The distribution is calculated based on a survey by CHARLS (2013), which asks the rural residents how much the annual contribution is if they have participated in NRPS.

Figure 3: A visual representation of the reversed DiD strategy



Notes: The blue points are the control counties that are to be treated *after* the nationwide expansion; the green points are the treated counties before and after the expansion. The red line and arrow are the magnitude and direction of the effect of policy expansion on the control counties.

Table 3: A comparison of village characteristics between CHARLS and CFPS

	CHARLS				CFPS			
NRPS covered year	2009	2010	2011	2012	2009	2010	2011	2012
Basic information								
Number of households	566	601	527	599	525	516	545	556
Population aged 60+	0.19	0.20	0.23	0.22	0.17	0.20	0.21	0.20
Agricultural land	0.72	0.74	0.71	0.65	0.68	0.74	0.72	0.67
Public facilities								
whether main road is paved	0.62	0.64	0.55	0.53	0.55	0.64	0.59	0.62
Whether mainly use tap water	0.43	0.46	0.49	0.50	0.38	0.45	0.41	0.47
whether use gas as fuel	0.25	0.33	0.31	0.26	0.26	0.31	0.25	0.33
Whether outdoor sports court	0.33	0.40	0.36	0.39	0.49	0.41	0.37	0.40
Whether a kindergarten	0.39	0.44	0.46	0.40	0.40	0.51	0.37	0.31
Whether a primary school	0.51	0.42	0.64	0.54	0.49	0.57	0.71	0.65
Economic conditions								
Pork price (¥/500g)	14.3	13.3	13.8	13.7	13.51	13.17	13.15	13.62
Egg price (¥/500g)	6.19	6.27	6.07	6.13	6.23	5.86	6.13	6.42
Manual daily wage (¥)	64.0	66.9	66.3	69.6	61.9	66.0	69.3	69.2

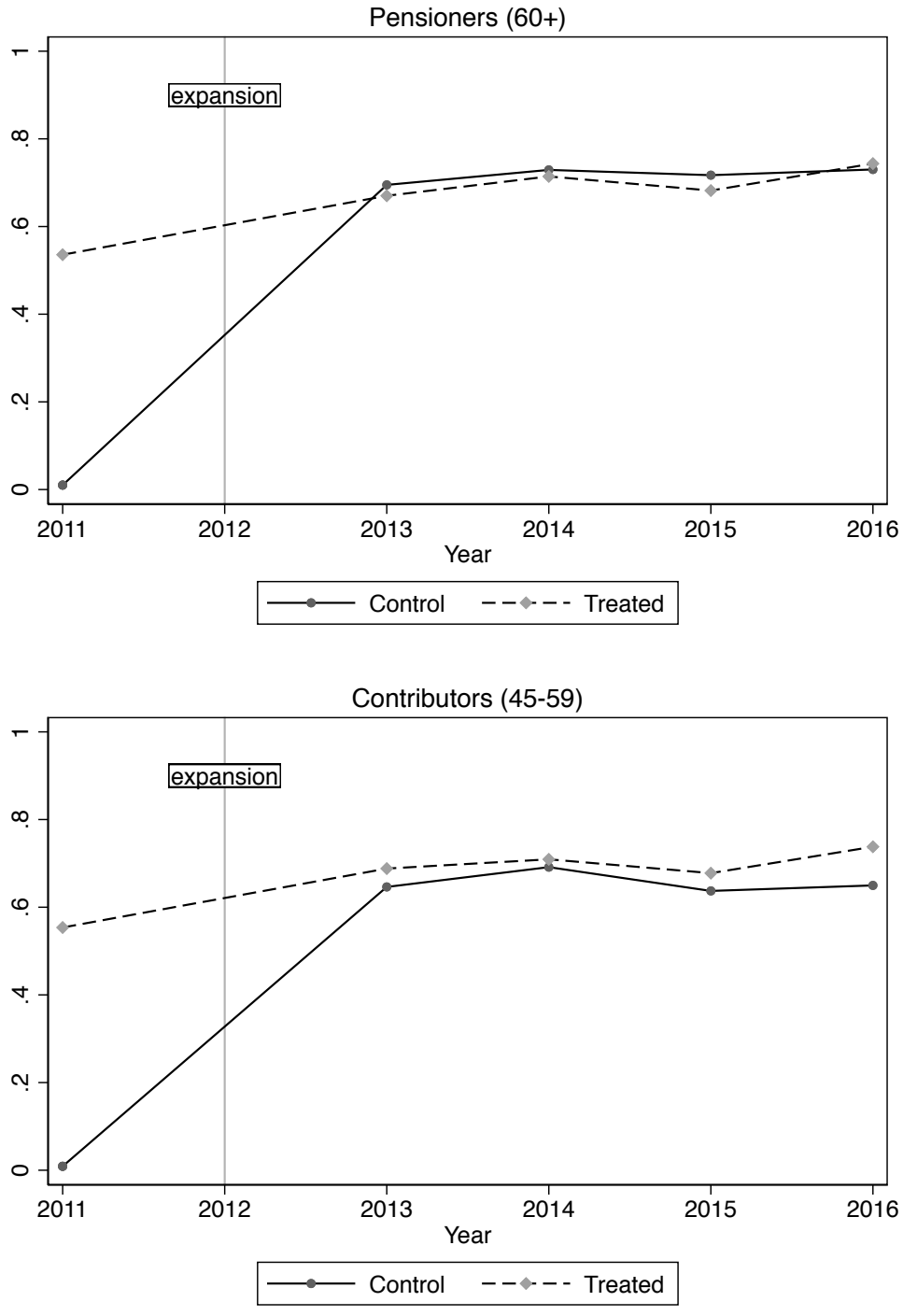
Notes: The table uses the village level surveys in CHARLS (2011) and CFPS (2012), separately. Both surveys have surveyed the village officers.

Table 4: Basic characteristics of the sample

	Initial contributors	Initial pensioners
Average age	53.0	68.9
Percentage working	0.87	0.64
Average weekly working hours	43.4	35.1
Percentage married	0.88	0.75
Average schooling year	5.00	2.76
Average number of living children	2.27	3.54
Percentage self-reported as poor or fair health	0.74	0.79
Median total non-housing non-financial asset	727	269
Median total non-housing financial asset	500	500
Number of observations	5474	4617

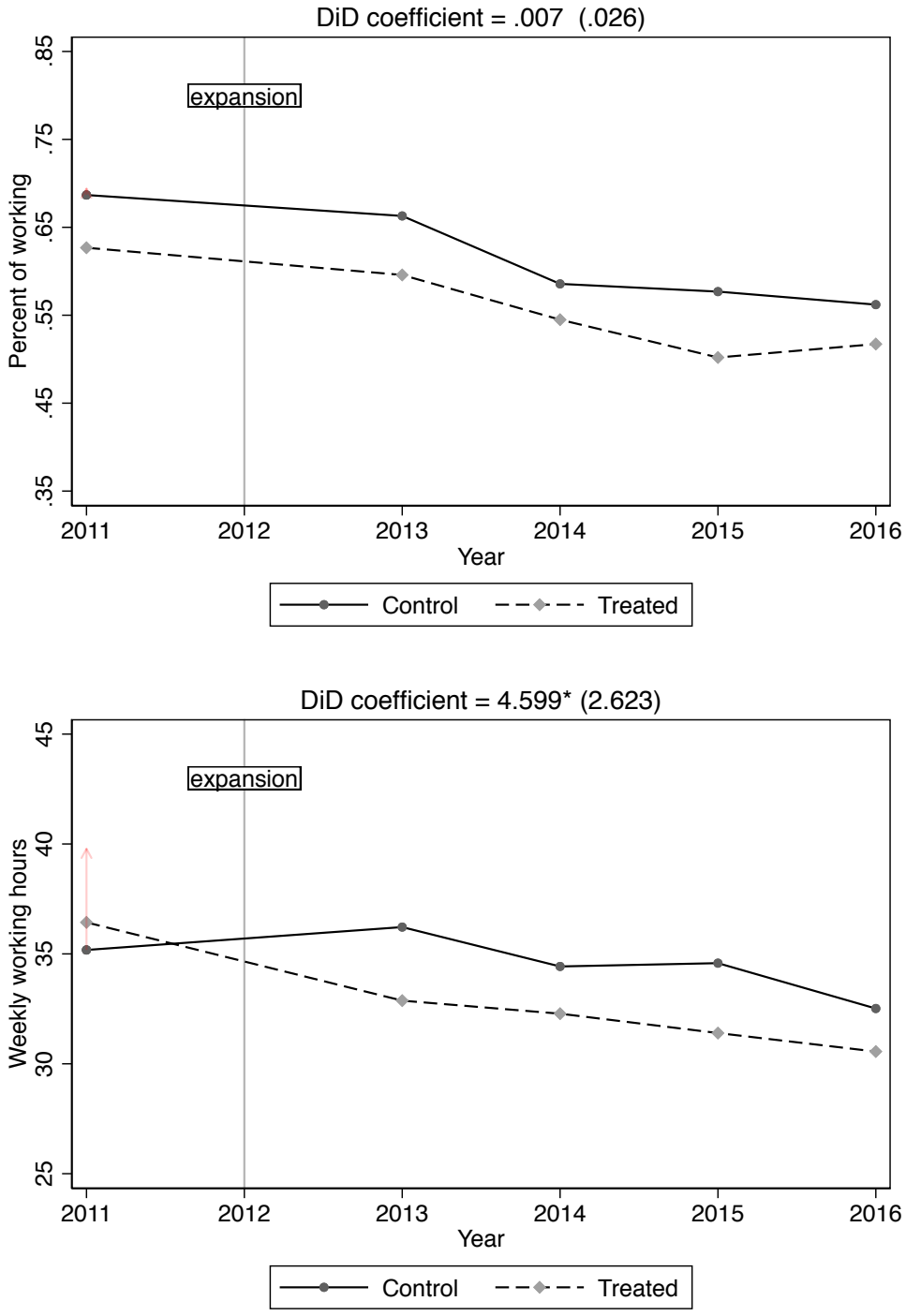
Notes: The information calculated in the table uses CHARLS (2011).

Figure 4: NRPS Participation Rate



Notes: The solid line and the dashed line represent, respectively, the control counties that were *not* treated and the countries that were treated before the nationwide expansion in 2012.

Figure 5: The effect of NRPS on the initial pension's labor supply



Notes: The solid line and the dashed line represent, respectively, the control counties that were *not* treated and the countries that were treated before the nationwide expansion in 2012. The red arrow indicates the size and direction of the effect. The standard error of the DiD coefficient is in parentheses, and it is clustered at the county level. *** p<0.01, ** p<0.05, * p<0.1. The parallel trend assumption has been examined by the Granger test (Granger, 1969). The placebo estimates are close to zero and statistically insignificant, suggesting the post-policy trends are parallel.

Table 5: The effect of NRPS on the pensioner's labor supply

	Whether working		Weekly work hours if working		Weekly work hours including zeros	
	$\mathbb{E}[P]$		$\mathbb{E}[L\|P=1]$		$\mathbb{E}[L]$	
	(1)	(2)	(3)	(4)	(5)	(6)
DiD coefficient	0.00714	0.00442	4.599*	6.103**	2.934	2.822
	(0.0261)	(0.0295)	(2.623)	(2.532)	(1.855)	(1.855)
Average	0.69	0.69	35.18	35.18	23.89	23.89
Percent change	1.0%	0.6%	13.1%	17.3%	12.3%	11.8%
Controls	No	Yes	No	Yes	No	Yes
Cohort FE	No	Yes	No	Yes	No	Yes
Individual FE	No	Yes	No	Yes	No	Yes
Observations	4,617	4,617	2,899	2,899	4,617	4,617

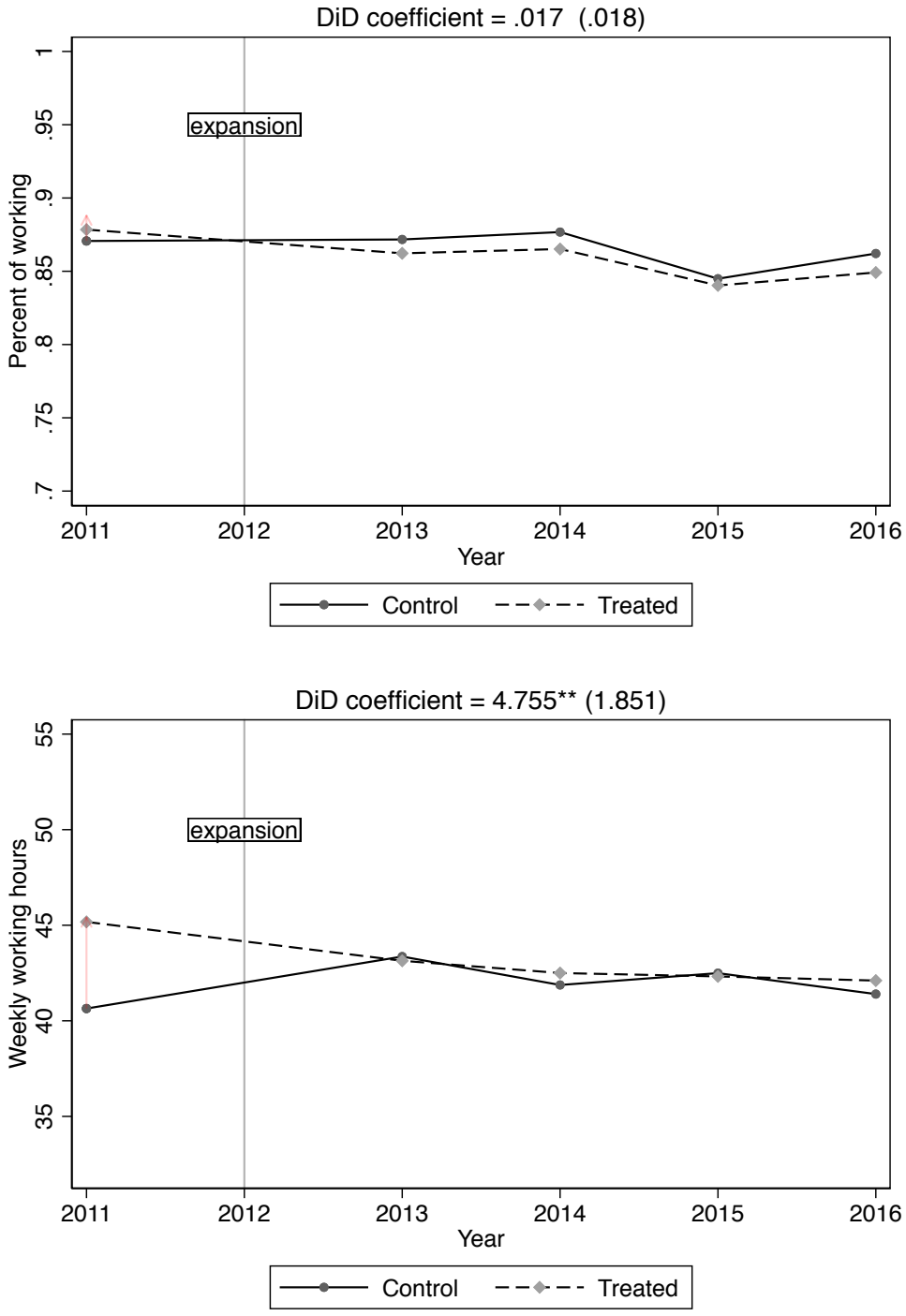
Notes: Control variables include marital status and number of children. Standard errors are clustered at the county level. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: The heterogeneous effect of NRPS on pensioner's labor supply

	(1) $\mathbb{E}[P]$	(2) $\mathbb{E}[L\|P=1]$	(3) $\mathbb{E}[L]$	(4) $\mathbb{E}[P]$	(5) $\mathbb{E}[L\|P=1]$	(6) $\mathbb{E}[L]$
Panel A: Age brackets	Younger pensioner (60-69)			Older pensioner (70+)		
DiD coefficient	0.00548	6.163**	4.863**	0.0111	6.238	-0.366
	(0.0339)	(2.799)	(2.265)	(0.0457)	(4.549)	(2.173)
Average	0.78	35.9	27.6	0.47	32.6	15.3
Percent change	0.7%	17.2%	17.6%	2.4%	19.2%	-2.4%
Observations	3,012	2,221	3,012	1,605	678	1,605
Panel B: Health status	Poor health condition			Good health condition		
DiD coefficient	0.00289	6.396**	3.259*	0.00537	2.832	1.994
	(0.0349)	(2.974)	(1.949)	(0.0620)	(4.202)	(3.133)
Average	0.68	35.3	24.0	0.75	36.0	26.6
Percent change	0.4%	18.1%	13.6%	0.7%	7.9%	7.5%
Observations	2,621	1,646	2,621	709	473	709
Panel C: Non-housing assets	Low asset level ($<$ median)			High asset level ($>$ median)		
DiD coefficient	0.0112	7.554*	3.459	-0.00799	2.934	0.926
	(0.0391)	(4.082)	(2.669)	(0.0391)	(2.698)	(2.203)
Average	0.65	33.2	21.4	0.72	37.9	27.0
Percent change	1.7%	22.8%	16.2%	-1.1%	7.7%	3.4%
Observations	2,084	1,219	2,084	2,083	1,402	2,083

Notes: The initial age bracket, health condition, and non-housing asset level are reported in the year 2011. Control variables include marital status. Cohort and individual fixed effects are used. Standard errors are clustered at the county level. *** p<0.01, ** p<0.05, * p<0.1.

Figure 6: Labor supply of the initial contributors



Notes: The solid line and the dashed line represent, respectively, the control counties that were *not* treated and the countries that were treated before the nationwide expansion in 2012. The red arrow indicates the size and direction of the effect. The standard error of the DiD coefficient is in parentheses: *** p<0.01, ** p<0.05, * p<0.1. The parallel trend assumption has been examined by the Granger test (Granger, 1969). The placebo estimates are close to zero and statistically insignificant, suggesting the post-policy trends are parallel.

Table 7: The effect of NRPS on initial contributor's labor supply

	Whether working		Weekly work hours if working		Weekly work hours including zeros	
	$\mathbb{E}[P]$		$\mathbb{E}[L\|P=1]$		$\mathbb{E}[L]$	
	(1)	(2)	(3)	(4)	(5)	(6)
DiD coefficient	0.0172	0.0187	4.755**	4.765**	5.026***	4.767***
	(0.0184)	(0.0182)	(1.851)	(1.923)	(1.883)	(1.804)
Average	0.87	0.87	40.64	40.64	34.90	34.90
Percent change	2.0%	2.2%	11.7%	11.7%	14.4%	13.7%
Controls	No	Yes	No	Yes	No	Yes
Cohort FE	No	Yes	No	Yes	No	Yes
Individual FE	No	Yes	No	Yes	No	Yes
Observations	5,474	5,474	4,714	4,714	5,474	5,474

Notes: Control variables include marital status, number of children. Standard errors are clustered at the county level. *** p<0.01, ** p<0.05, * p<0.1.

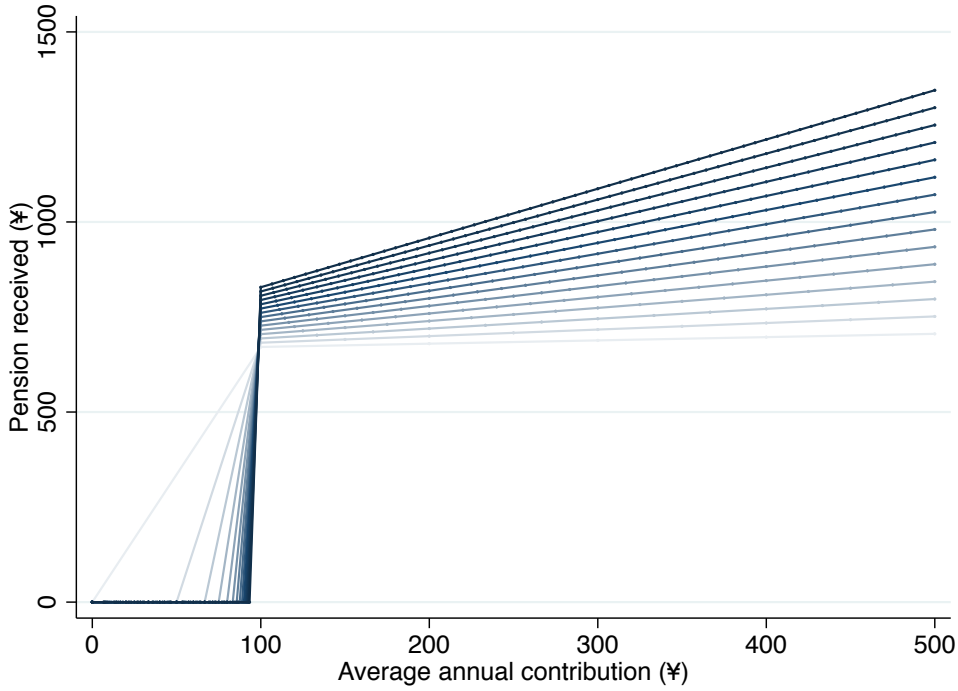
Table 8: The heterogeneous effect of NRPS on contributor's labor supply

	(1) $\mathbb{E}[P]$	(2) $\mathbb{E}[L\|P=1]$	(3) $\mathbb{E}[L]$	(4) $\mathbb{E}[P]$	(5) $\mathbb{E}[L\|P=1]$	(6) $\mathbb{E}[L]$
Panel A: Non-housing assets	Low asset level (< median)			High asset level (> median)		
DiD coefficient	0.0453	6.772*	6.519**	0.00131	-1.225	-0.467
	(0.0400)	(3.672)	(3.255)	(0.0347)	(3.400)	(3.303)
Average	0.86	38.83	33.08	0.83	44.30	35.87
Percent change	5.3%	17.4%	19.7%	0.2%	-2.8%	-1.3%
Observations	2,277	1,902	2,277	2,277	1,919	2,277
Panel B: Age brackets	Younger contributors (45-54)			Older contributors (55-59)		
DiD coefficient	0.0324	5.001**	5.695***	-0.00481	0.911	1.755
	(0.0197)	(2.011)	(1.914)	(0.0375)	(3.668)	(3.583)
Average	0.87	41.84	35.95	0.87	39.26	33.73
Percent change	3.7%	12.0%	15.8%	-0.6%	2.3%	5.2%
Observations	4,122	3,600	4,122	1,651	1,382	1,651

Notes: The median non-housing financial asset is ¥500 for the initial contributors. Control variables are marital status and number of children. Cohort and individual fixed effects are included. Standard errors are clustered at the county level. *** p<0.01, ** p<0.05, * p<0.1.

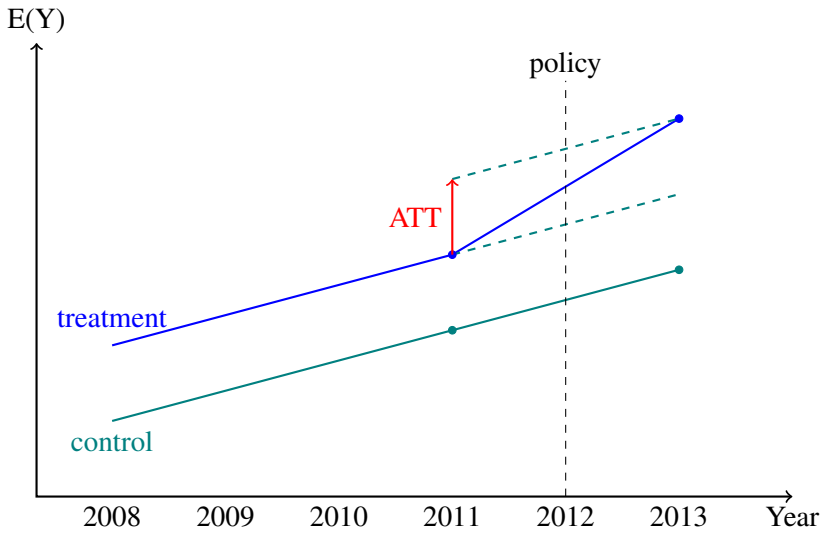
Appendix

Appendix Figure 1: Pension formula for the initial contributors



Notes: Each line present a pension formula for a different contributor who has a different initial age when the pension scheme was covered. The lightest and the darkest lines represent the contributor who was 59 and 45, respectively, when the NRPS was covered. Note that the darkest line is the same as the pension formula in Figure 1. The pattern of different pension formulae is very similar to Figure 1. That is, paying the minimal requirement is very financially attractive, but it is less financially appealing to pay an additional ¥100. Also, paying 15 years of miminal contribution generates ¥828 in pension, while paying one year of minimal contribution generates ¥671.

Appendix Figure 2: A visual representation of the standard DiD strategy



Notes: The green points are the control counties, and the blue points are the treated counties. The red line and arrow are the magnitude and direction of the effect of policy on the treated counties.

Appendix Table 1: The effect of expected pension (in ¥100) on initial contributor's labor supply

	Whether working $\mathbb{E}[P]$		Weekly work hours if working $\mathbb{E}[L\|P=1]$		Weekly work hours including zeros $\mathbb{E}[L]$	
	(1)	(2)	(3)	(4)	(5)	(6)
DiD coefficient	0.00239	0.00269	0.646***	0.663**	0.684***	0.666***
	(0.00241)	(0.00240)	(0.246)	(0.260)	(0.249)	(0.245)
Average	0.87	0.87	40.64	40.64	34.90	34.90
Percent change	0.3%	0.3%	1.6%	1.6%	2.0%	1.9%
Controls	No	Yes	No	Yes	No	Yes
Cohort FE	No	Yes	No	Yes	No	Yes
Individual FE	No	Yes	No	Yes	No	Yes
Observations	5,474	5,474	4,714	4,714	5,474	5,474

Notes: Control variables include marital status, number of children. Standard errors are clustered at the county level. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table 2: The effect of NRPS on in two subsamples

	(1) $\mathbb{E}[P]$	(2) $\mathbb{E}[L\|P=1]$	(3) $\mathbb{E}[L]$	(4) $\mathbb{E}[P]$	(5) $\mathbb{E}[L\|P=1]$	(6) $\mathbb{E}[L]$
Subsamples	counties treated in 2009 and 2012			counties treated in 2010 and 2012		
DiD coefficient	0.0295	5.415*	3.230*	-0.00432	6.132**	2.087
	(0.0350)	(2.897)	(1.893)	(0.0297)	(2.700)	(1.824)
Average	0.63	35.36	33.97	0.65	22.59	22.59
Percent change	4.7%	15.3%	15.3%	-0.7%	27.1%	9.2%
Observations	2,760	1,786	2,760	3,629	2,319	3,629

Notes: The first subsample contains all counties that were treated in 2009 and 2012; the second subsample contains all counties treated in 2010 and 2012. Control variables are marital status and number of children. Cohort and individual fixed effects are included. Standard errors are clustered at the county level. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table 3: The effect of NRPS on family support

	Coresidence with children	Net private transfer from non-coresiding children		
	(1) yes = 1	(2) pooled	(3) coreside w/ children	(4) not coreside w/ children
DiD coefficient	-0.00836	-290.3**	-67.60	-331.2
	(0.0366)	(141.6)	(228.4)	(289.1)
Average	0.54	1281.09	869.56	1685.07
Percent change	-1.5%	-22.7%	-7.8%	-19.7%
Controls	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes
Observations	14,094	13,177	5,921	6,914

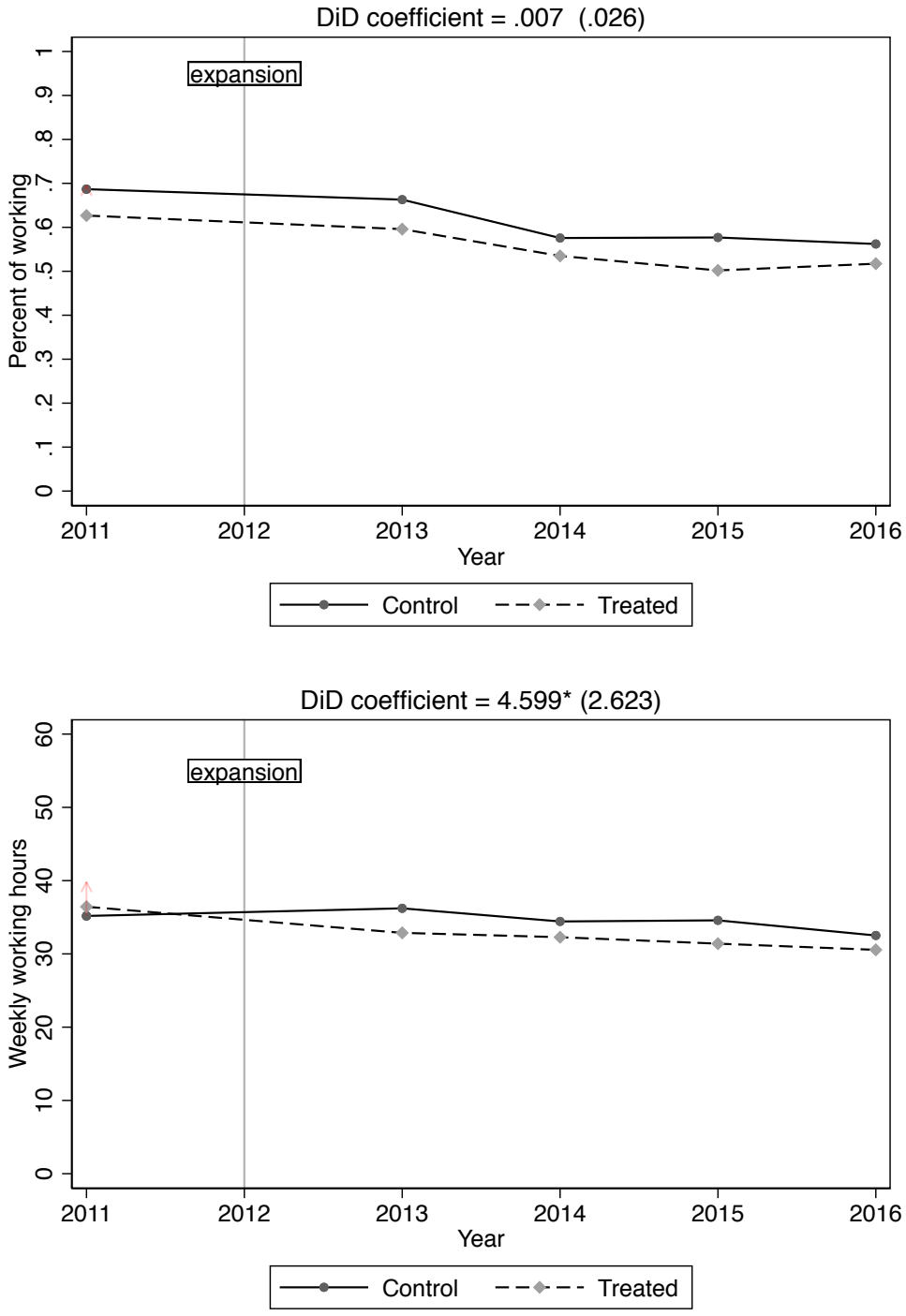
Notes: Control variables include marital status, number of children. Standard errors are clustered at the county level. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table 4: The effect of NRPS on health and agricultural assets

	(1)	(2)	(3)	(4)	(5)	(6)
	Health measures			Agricultural assets		
	self-reported good health	self-reported no functional limitation	objectively measured BMI	land size (in acre)	agricultural fixed capital	agricultural stock
DiD coefficient	0.00680	0.00973	0.253***	0.428*	242.7**	318.2**
	(0.0282)	(0.0251)	(0.0960)	(0.221)	(122.7)	(158.0)
Average	0.190	0.249	22.0	2.34	1758.26	1357.37
Percent change	3.6%	3.9%	1.2%	18.3%	13.8%	23.4%
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,884	4,614	3,418	2,915	3,780	3,758

Notes: the self-reported good health is a dummy that is equal to one if one reports his health status as either fair or poor. The self-reported functional difficulty is also a dummy, which equals one if one reports any difficulties in functional activities, such as difficulty in walking or jogging for one kilometer. The survey team measures the body mass index (BMI) on site. Standard errors are clustered at the county level. *** p<0.01, ** p<0.05, * p<0.1

Appendix Figure 3: Labor supply of the initial pensioner (zoom out)



Notes: The solid line and the dashed line represent, respectively, the control counties that were *not* treated and the countries that were treated before the nationwide expansion in 2012. The red arrow indicates the size and direction of the effect. The standard error of the DiD coefficient is in parentheses: *** p<0.01, ** p<0.05, * p<0.1. The parallel trend assumption has been examined by the Granger test (Granger, 1969). The placebo estimates are close to zero and statistically insignificant, suggesting the post-policy trends are parallel.

Appendix Table 5: The heterogeneous effect of NRPS on contributor's labor supply

	(1) $\mathbb{E}[P]$	(2) $\mathbb{E}[L\|P=1]$	(3) $\mathbb{E}[L]$	(4) $\mathbb{E}[P]$	(5) $\mathbb{E}[L\|P=1]$	(6) $\mathbb{E}[L]$
Non-housing assets	Low asset level ($<$ median)			High asset level ($>$ median)		
DiD coefficient	0.0412	8.860***	10.33***	0.0236	0.660	1.313
	(0.0269)	(3.231)	(2.895)	(0.0266)	(2.632)	(2.346)
Average	0.94	39.82	37.02	0.81	41.52	32.96
Percent change	4.4%	22.2%	27.9%	2.9%	1.6%	4.0%
Observations	2,737	2,476	2,737	2,737	2,238	2,737

Notes: The median non-housing non-financial asset is ¥728 for the initial contributors. Control variables are marital status and number of children. Cohort and individual fixed effects are included. Standard errors are clustered at the county level. *** p<0.01, ** p<0.05, * p<0.1.