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Causal Effects or Specification Effects? Evidence from China's Rural Pension Program

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Abstract: China's rapid population aging has increased the importance of pension policy, especially in rural areas where many older adults continue to rely on work and family support. Since its introduction in 2009, the New Rural Social Pension Insurance (NRSPI) has been widely studied, yet evidence on its effects remains mixed. Some studies find that pension receipt reduces elderly labor supply and affects household savings, while others report weak or insignificant effects. This study reassessed the effects of NRSPI receipt using the 2018 China Health and Retirement Longitudinal Survey (CHARLS) and a fuzzy regression discontinuity design. Estimates were compared across alternative bandwidths, functional forms, polynomial specifications, and outcome measures. The results showed substantial sensitivity to model specification. Estimated effects varied in magnitude and statistical significance and, in some cases, coefficients changed sign. Although some specifications suggested that NRSPI receipt reduced certain types of work among older adults, these effects were not consistently reproduced. The findings therefore suggested that strong causal claims about the effects of China's rural pension system should be interpreted with caution.

Keywords: New Rural Social Pension Insurance, Rural Elderly, Fuzzy Regression Discontinuity, Specification Sensitivity, Robustness, Pension Policy Evaluation

1. Introduction

Is China's rural pension policy effective? China is currently experiencing a rapidly aging population. China has become an aging society in the past few decades. In 1999, China became an aging society, with individuals aged 60 years and over accounting for 10% of the total population (National Bureau of Statistics of China, 2021). Furthermore, the population aged 60 years and above has reached 264 million in 2021, representing 18.7% of the total population. The aging problem is even more pronounced in China's rural areas, where 23.8% of the population is aged 60 years and above, compared to 15.8% in urban areas (National Bureau of Statistics of China, 2022). As a result, how to provide stable income and basic economic security for older people has become an increasingly important social and policy issue.

Social pension insurance is a crucial component of the social security system, as it provides basic income to the elderly and ensures that their fundamental livelihood needs are met. The Chinese government has adopted an approach of improving the pension security system, which is a key strategy for countries facing a growing aging population and increasing social pension demands (Bonenkamp et al., 2017). The State Council of China launched a new rural social pension insurance system in 2009, which was implemented nationwide in 2012. This system, known as the New Rural Social Pension Insurance (NRSPI), aims to provide economic support to elderly rural individuals to meet their basic livelihood needs. The NRSPI participants included residents with a rural household registration who

were over 16 years old (excluding school students) and did not participate in basic pension insurance for employees. Insured individuals receive pension payments upon reaching the age of 60.

NRSPI has garnered widespread attention since its inception, prompting extensive research in academic circles. A large literature has examined its effects on household expenditure, income, labor supply, poverty, intergenerational transfers, and elderly welfare. However, there is no consensus on the effects of the NRSPI, even when studies examine similar outcomes. For labor supply, several studies find that pension receipt increases retirement or reduces elderly labor supply, particularly agricultural work or working hours (Chenchen & Wen, 2015; Qin, 2018; Huang & Zhang, 2021), while others find little or no statistically significant effect on either labor-force participation or hours worked (Xie, 2015). The evidence on consumption is similarly mixed. Some studies find that pension benefits increase household expenditure, food consumption, or household income (Zhang et al., 2013; Huang & Zhang, 2021; Zheng & Zheng, 2017), whereas others find only small or statistically insignificant effects on total consumption and specific expenditure categories (Sun and Ji 2016). Studies of broader welfare outcomes also reach different conclusions, with some documenting improvements in health and subjective well-being and others finding limited or insignificant effects (Chen, 2018). Taken together, these differences raise an important question about how robust the estimated effects of the NRSPI are to alternative empirical specifications.

This issue is especially important because many early studies rely on conventional regression methods, propensity score matching, or other observational approaches. Matching methods can improve comparability between treatment and comparison groups by balancing observed characteristics (Rosenbaum & Rubin, 1983; Heckman et al., 1998). However, their causal interpretation relies on the assumption that treatment selection can be adequately explained by observed covariates, and they cannot by themselves eliminate bias arising from unobserved confounding (LaLonde, 1986; Abadie & Imbens, 2006; Imbens & Wooldridge, 2009). Pension recipients differ from no recipients in health, employment capacity or retirement preferences. As a result, estimates based mainly on selection on observables will not provide strong causal identification.

2. Literature Review

2.1 The Effects of Social Pensions

Social pension programs are designed to provide older adults with a stable source of income and reduce their dependence on labor and family support. Standard economic theory suggests that pension income can reduce labor supply by increasing non-labor income and relaxing household budget constraints. Evidence from several countries supports this mechanism. Studies from Brazil (de Carvalho Filho, 2008), India (Kaushal, 2014), and Thailand (Jansuwan & Zander, 2021) find that pension receipt can reduce working hours or encourage older adults to leave agricultural work. However, the effects of pensions are not always consistent. In settings where pension benefits are small relative to household needs, older adults continue working even after receiving pension income. Some studies find that limited welfare support can maintain elderly labor participation (Oshio et al., 2011; Cerda, 2005). These findings suggest that the effect of pension income depends on the economic and institutional environment.

Research on China's New Rural Social Pension Insurance (NRSPI) also reports mixed findings. Existing studies examine a wide range of outcomes, including income, consumption, labor supply, savings, agricultural production, and intergenerational transfers. Some scholars argue that the NRSPI has significantly increased rural household expenses (Qin, 2018), whereas others have found improved income levels, thereby narrowing the urban-rural income gap (Qiong, 2015) and continuously enhancing the basic livelihood standards of the

rural elderly (Zhang et al., 2013). Other scholars, such as Xie (2015), have reported that the benefits of the NRSPI are limited, with little impact on the elderly's expenses, labor supply, and welfare. The existing literature does not provide a single clear conclusion about the behavioral effects of the NRSPI. These differences reflect genuine heterogeneity across households, regions, and outcomes. However, they also reflect differences in data, identification strategies, and empirical specifications. This makes the robustness of estimated pension effects an important issue in evaluating the program.

2.2 Causal Identification in Pension Evaluation

Estimating the causal effects of pension receipt is challenging because participation is not randomly assigned. Conventional regression and matching methods can reduce differences based on observed characteristics, but they cannot fully address selection on unobserved factors (Rosenbaum and Rubin 1983; Heckman et al. 1998; Imbens and Wooldridge 2009). Regression discontinuity design (RDD) provides a stronger identification strategy when eligibility is determined by a clear institutional rule. In the case of the NRSPI, individuals become eligible for pension payments after age 60, creating a discontinuity in the probability of receiving benefits. Because actual receipt is not perfectly determined by age, a fuzzy RDD can be used to estimate local causal effects around the cutoff. However, RDD estimates still depend on important empirical choices.

2.3 Specification Sensitivity in Regression Discontinuity Designs

A key issue in RDD estimation is the choice of specification. Different bandwidths involve a trade-off between focusing on observations close to the cutoff and retaining enough observations for precise estimation (Imbens & Kalyanaraman, 2012). The choice of bandwidth can therefore affect both the estimated treatment effect and statistical inference (Calonico et al., 2014). Functional form choices are also important. In particular, higher-order polynomial specifications can generate unstable estimates near the cutoff and increase the risk of Type I errors by producing spurious statistical significance. This problem is particularly important in applied research because commonly used statistical packages make it easy to add quadratic, cubic, or higher-order polynomial terms, even when such specifications are not well justified by the data. Consequently, researchers obtain apparently significant treatment effects that are driven by functional-form choices rather than by a genuine discontinuity at the cutoff. Modern RDD practice therefore generally recommends avoiding high-order global polynomial specifications. (Gelman & Imbens, 2019). Other choices, such as allowing different slopes on the two sides of the cutoff, including covariates, changing the analytical sample, further affect the estimated treatment effect (Lee & Lemieux, 2010).

2.4 Conceptual Framework

Economic theory predicts that pension income can reduce elderly labor supply by providing a stable source of income and lowering the need to work (Fetter & Lockwood, 2018). However, retirement and labor decisions also depend on health, household resources, and other economic constraints (French, 2005). When pension benefits are relatively small, additional pension income therefore produces only limited changes in behavior. This issue is particularly relevant to the NRSPI, which provides basic rather than full income replacement for rural elderly individuals. Older adults differ in their dependence on labor income, household resources, and family responsibilities. The effects of pension receipt therefore vary across individuals. Given the theoretical ambiguity, we consider two possible hypotheses on the effects of the NRSPI.

Hypothesis 1: Pension receipt reduces the working hours of rural elderly individuals. If pension benefits provide sufficient income support, recipients can reduce their reliance on labor income and work fewer hours.

Hypothesis 2: Pension receipt has no significant effect on the working hours of rural elderly individuals. If pension benefits are insufficient to replace labor income, recipients remain dependent on work and therefore do not substantially change their working hours.

3. Methodology, Data and Variables

3.1 Methodology

Estimating the causal effect of NRSPI receipt is difficult because pension receipt is not randomly assigned. We therefore use a fuzzy regression discontinuity design (FRDD) based on the age rule of the NRSPI. The statutory eligibility age is 60, but actual pension receipt does not change perfectly at this threshold, making the design fuzzy rather than sharp (Cattaneo et al., 2024).

Let χ_i denote age and c the cutoff used in a given specification. The running variable is defined as

$$R_i = x_i - c$$

and the cutoff indicator is

$$Z_i = 1(R_i \geq 0)$$

Let D_i indicate actual NRSPI receipt and Y_i denote the outcome of interest. The fuzzy RDD estimand is

$$\tau_{FRD} = \frac{\lim_{r \downarrow 0} E[Y_i | R_i = r] - \lim_{r \uparrow 60} E[Y_i | R_i = r]}{\lim_{r \downarrow 0} E[D_i | R_i = r] - \lim_{r \uparrow 60} E[D_i | R_i = r]}$$

Under the standard assumptions of the fuzzy RDD, τ_{FRD} identifies the local average treatment effect of NRSPI receipt for individuals whose receipt status is affected by crossing the cutoff.

We estimate the model using two-stage least squares (2SLS). The baseline first-stage equation is

$$D_i = \alpha_0 + \pi Z_i + \alpha_1 R_i + \alpha_2 Z_i R_i + \varepsilon_i$$

and the outcome equation is

$$Y_i = \beta_0 + \tau D_i + \beta_1 R_i + \beta_2 Z_i R_i + u_i$$

Here, D_i is treated as endogenous and instrumented by Z_i. The interaction term $Z_i R_i$ allows the age slope to differ on the two sides of the cutoff.

3.2 Data and Sample Construction

This study uses the 2018 China Health and Retirement Longitudinal Survey (CHARLS) (Zhao et al., 2014). CHARLS is a nationally representative household survey conducted by the National School of Development at Peking University and contains detailed information on demographic characteristics, employment, pensions, health, household expenditure, and intergenerational transfers (Zhao et al., 2013).

Observations with missing age or NRSPI receipt information are excluded because these variables are required to define treatment status and the running variable. When constructing total annual working hours, structural zeros are coded as zero only when respondents report no participation in the relevant activity, whereas item nonresponses are treated as missing. We also exclude observations with total annual working hours of 6,000 hours or more to reduce the influence of extreme values.

3.3 Variables and Descriptive Statistics

The treatment variable is whether receipt of NRSPI, age is measured in years with monthly precision, as a running variable. The outcomes are total annual working hours, agricultural working hours, and employment working hours. Total working hours are

constructed as the sum of annual working hours across the different forms of economic activity recorded in CHARLS. Agricultural working hours measure time spent on agricultural activities, while employment working hours measure time spent working for an employer.

Table 1. Variable Definitions and Descriptive Statistics

Variable	Definition	Mean	SD	N
Total Working Hours	Total annual working hours across all recorded economic activities	1,083.9	1,392.4	9,219
Agricultural Working Hours	Annual hours spent on agricultural activities	493.2	792.7	9,219
Employment Working Hours	Annual hours spent working for an employer	218.4	575.2	9,219
NRSPI Receipt	Currently receives NRSPI benefits = 1; otherwise = 0	0.5	0.5	9,219
Age	Age in years, measured with monthly precision	61.967	9.990	9,219
Gender	Male = 1; Female = 0	0.4	0.5	9,219
Health	Self-reported health status; higher values indicate worse health	3.0	1.0	8,564
Marriage	Has a spouse = 1; otherwise = 0	0.9	0.4	9,219
Area	Rural residence = 1; otherwise = 0	0.9	0.3	9,219

4. Results and Discussion

4.1 First-Stage Discontinuity in NRSPI Receipt

We first examine whether age generates a discontinuous change in NRSPI receipt. Figure 1 compares pension receipt around the statutory eligibility age of 60 and the empirical cutoff of 60.16, which represents 60 and two months. The statutory eligibility age for the NRSPI is 60. However, pension receipt does not necessarily begin immediately upon reaching age 60 because eligible individuals must submit the required documents and complete administrative procedures. This creates a short delay between formal eligibility and actual benefit receipt. We therefore report results using both the policy-defined cutoff of 60 and the empirically observed cutoff of 60.16.

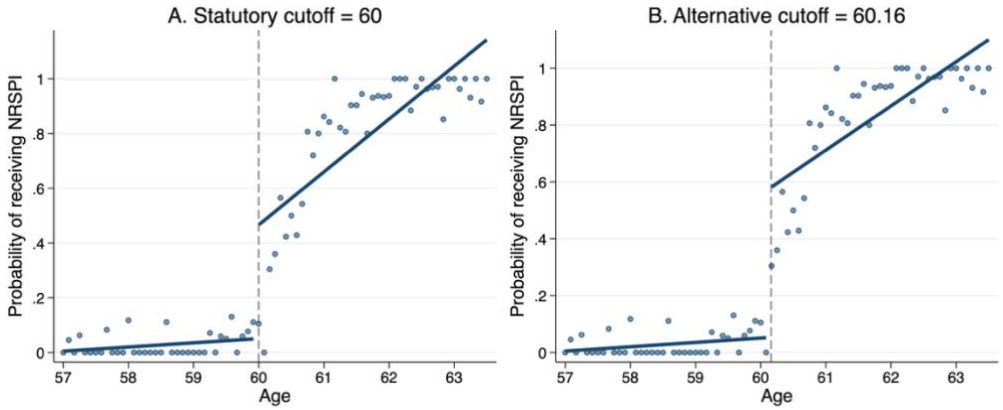

Figure 1. Age and the Probability of Receiving NRSPI Benefits

Table 2. First Stage Estimates for NRSPI Receipt

	Age 60	Age 60.16
Cutoff indicator	0.132***	0.293***
	(0.047)	(0.049)
First-stage -statistic	8.06	35.96
Observations	860	856
Bandwidth	1.5	1.5
Polynomial order	Linear	Linear

*Note:*** p < 0.01

As shown in Table 2, statistically significant discontinuities in NRSPI receipt are observed at both cutoffs. At age 60, crossing the cutoff is associated with a 13.2 percentage-point increase in pension receipt. At age 60.16, the estimated discontinuity increases to 29.3 percentage points. The substantial difference between these two estimates shows that the strength of the first stage is highly sensitive to the exact location of the cutoff. The difference between the two first-stage estimates highlights the distinction between statutory eligibility and actual pension receipt. We treat age 60 as the primary cutoff because it is the institutionally predetermined eligibility cutoff. Age 60.16 is reported as a secondary operational cutoff to account for the administrative delay between eligibility and benefit receipt. Although the discontinuity is stronger at age 60.16, this does not make it theoretically preferable to the statutory cutoff. Instead, comparing the two cutoffs serves as a sensitivity check on how the timing of program implementation affects the results.

4.2 Impact of NRSPI on Working Hours

We next examine the estimated effect of NRSPI receipt on elderly working hours. Figure 2 presents the age profiles of total, agricultural, and employment working hours, while Table 3 reports IV estimates.

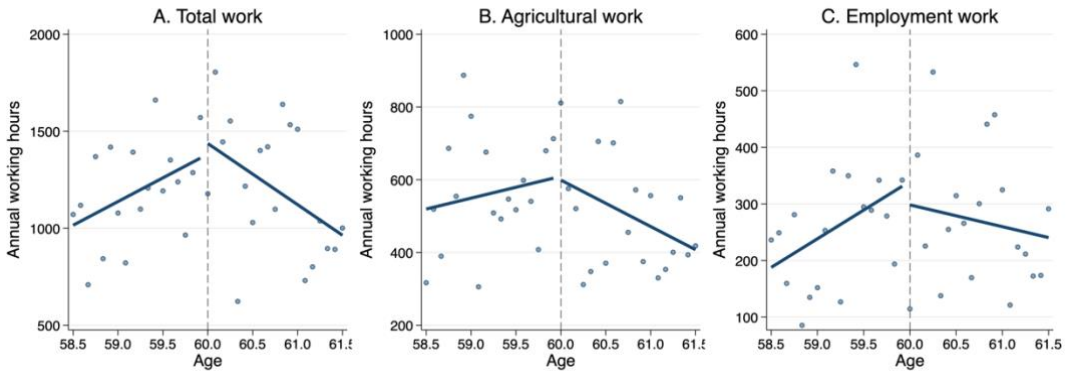

Figure 2. Age Profiles of Three Working Hours Outcomes

Table 3. IV Estimates of NRSPI Receipt on Working Hours

	Total Work	Agricultural Work	Employment Work
NRSPI Receipt	-511.426	-333.821	-32.065
	(682.267)	(393.641)	(291.045)
Observations	856	856	856
Bandwidth	1.5	1.5	1.5
Functional form	Linear	Linear	Linear

The estimated effects of NRSPI receipt on total working hours, agricultural working hours, and employment working hours are all statistically insignificant. We therefore next examine whether the results change across alternative bandwidths and functional forms.

4.3 Sensitivity to Bandwidth Choice

We first examine whether the estimated effects are sensitive to the choice of bandwidth. Table 4 reports the IV estimates using bandwidths of 0.5, 1, 1.5, 2, and 3 years around the cutoff.

Table 4. IV Estimates across Alternative Bandwidths

	0.5	1.0	1.5	2.0	3.0
Total Working Hours	-1549.114	-1115.468	-511.426	-308.459	-158.686
	(1404.454)	(1160.552)	(682.267)	(473.449)	(290.716)
Agricultural Working Hours	-1338.856	-805.152	-333.821	-371.342	-368.184**
	(845.276)	(687.111)	(393.641)	(272.066)	(164.858)
Employment Working Hours	132.775	88.887	-32.065	-71.026	47.554
	(590.516)	(487.334)	(291.045)	(205.606)	(126.227)
Observations	280	562	856	1,157	1,669

Note: ** $p < 0.05$

The estimates vary considerably across bandwidth choices. For total working hours, the estimated effect ranges from approximately -1549 to -159 annual hours and remains statistically insignificant. For agricultural working hours, the estimate is insignificant under narrower bandwidths but becomes statistically significant at the 3 year bandwidth, with an estimated reduction of about 368 annual hours. Employment working hours also change sign across bandwidths, although none of the estimates are statistically significant. These results show that conclusions about the effect of NRSPI receipt depend on the estimation window.

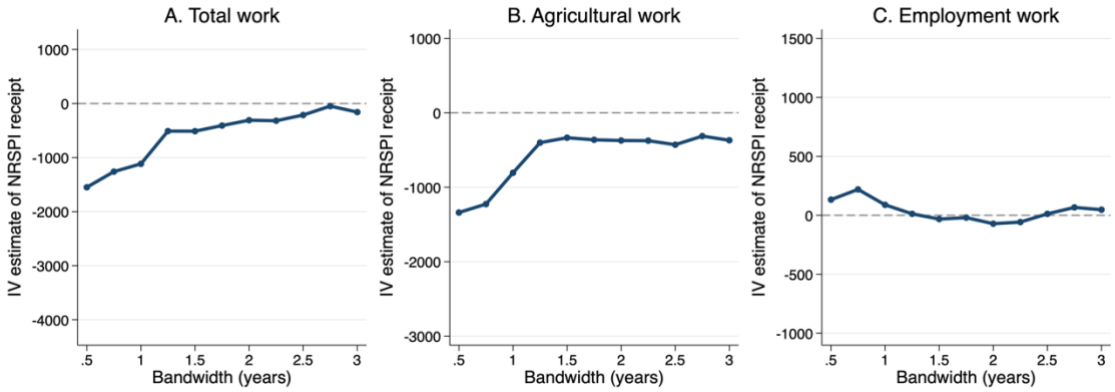

Figure 3. Sensitivity of IV Estimates to Bandwidth Choice

Figure 3 illustrates these patterns more clearly. The estimated effects on total and agricultural working hours remain negative across the bandwidth, while the estimate for employment working hours crosses zero several times as the bandwidth changes. This variation further shows that the estimated effect is not stable across alternative estimation windows.

4.4 Sensitivity to Functional Form

We next examine whether the estimates are sensitive to the functional form of the running variable. Figure 4 compares linear and quadratic specifications across alternative bandwidths.

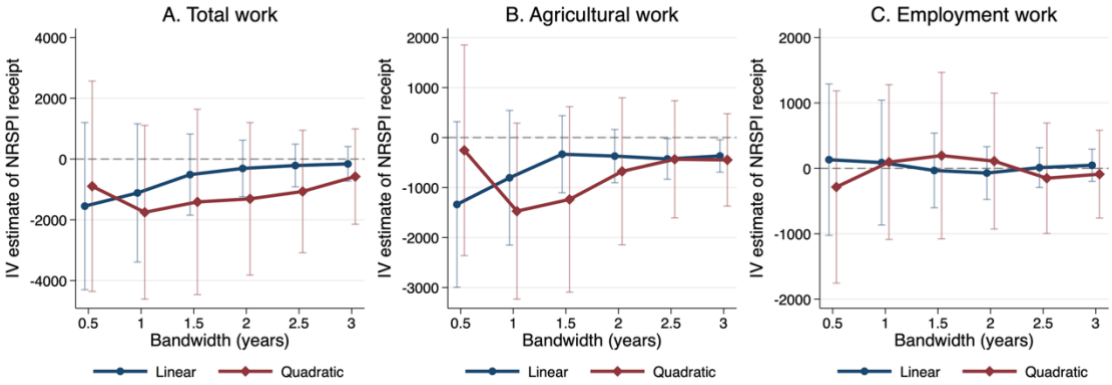

Figure 4. Sensitivity of IV Estimates to Functional Form

The estimates are also sensitive to the functional form of the running variable. At the 1.5 year bandwidth, none of the three working hour outcomes is statistically significant under either the linear or quadratic specification.

We then repeat the comparison at the 3 year bandwidth. Although the agricultural work effect is significant under the linear specification, it becomes insignificant under the quadratic specification. This indicates that the statistical significance of the estimated effect depends on the polynomial specification.

Table 5. Linear and Quadratic IV Estimates at the 3 Year Bandwidth

	Linear	Quadratic
Total Working Hours	-158.686	-575.127
	(290.716)	(801.716)
Agricultural Working Hours	-368.184**	-447.613
	(164.858)	(471.179)
Employment Working Hours	47.554	-88.685
	(126.227)	(342.369)
Observations	1,669	1,669
Bandwidth	3	3

Note: Robust standard errors are reported in parentheses. ** $p < 0.05$.

5. Discussion and Policy Implications

The results reveal substantial sensitivity to empirical specification choices. Under the specification, none of the three outcomes are statistically significant. However, changing the bandwidth alters the magnitude of the estimates, and the agricultural working hours becomes statistically significant at the 3 year bandwidth. This significance disappears when the same 3 year bandwidth is estimated using a quadratic rather than a linear specification.

The pattern differs across outcomes. Estimates for total working hours remain negative but statistically insignificant. Agricultural working hours also generally show negative estimates, but their statistical significance depends on the bandwidth and functional form. Employment working hours are less stable, with the estimated effect changing sign across specifications while remaining statistically insignificant.

These findings provide no robust evidence of a meaningful effect of the NRSPI on elderly working hours in our RDD analysis. However, the large standard errors and unstable

point estimates mean that economically meaningful effects cannot be ruled out. Interpretation also requires caution because eligibility is determined by age, whereas actual pension receipt depends on individual take-up. This selection complicates the interpretation of the discontinuity around the eligibility cutoff. A regression kink design provides an alternative approach if the program changes the age profile of labor supply rather than producing a discrete level change, although it would face similar concerns regarding pension take-up.

Household circumstances, including marital status and financial support from family members, affect both pension take-up and labor supply. The inability to fully account for these factors is an additional limitation of the analysis. Overall, the results provide no robust evidence of a meaningful treatment effect, but the magnitude and precision of the estimates remain sensitive to empirical choices and the underlying identification strategy. Evaluations of age-based social programs should therefore consider a range of reasonable specifications rather than rely on a single statistically significant estimate.

6. Conclusion

Using the 2018 CHARLS data and a fuzzy RDD, this study examined whether the estimated effects of NRSPI receipt on elderly working hours remained stable across alternative specifications. The estimates varied across cutoffs, bandwidths, and functional forms, providing no robust evidence of a meaningful labor-supply effect, although the imprecision of the estimates means that such an effect cannot be ruled out. These findings highlight the importance of reporting robustness checks and interpreting specification-dependent estimates cautiously.

7. Limitations

This study has several limitations. Although the analysis documents substantial variation across alternative empirical specifications, it does not identify which specification should be regarded as uniquely correct. The purpose of the analysis is therefore to assess the stability of existing causal conclusions rather than to select a single preferred estimate. Then, the analysis relies on the 2018 wave of CHARLS. The sensitivity documented in this study partly reflects the institutional and behavioral context of NRSPI implementation at that particular point in time.

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