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Public pensions and family dynamics: Eldercare, child investment, and son preference in rural China☆

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ABSTRACT

Using variations in the timing of the New Rural Pension Scheme (NRPS) across rural Chinese counties, we examine its effects on eldercare mode, child investment, and son preference. Our findings are three-fold: (1) After the introduction of NRPS, married sons are less likely to live with and provide care for their parents, while married daughters show no significant change in their caregiving behavior; (2) Parents reduce the brideprice for their sons but not the dowry for their daughters; (3) The sex ratio at birth becomes more balanced, indicating a reduction in son preference. These results suggest that public pension programs can significantly influence traditional family dynamics, including eldercare modes and cultural norms around gender preference.

1. Introduction

How do people prepare for life in old age? The answer affects not only household decisions like eldercare (Bonsang, 2009) and inter-vivo transfers (Cox, 1987) but also broader economic outcomes such as savings behavior (Laitner, 1988), child investment (Becker et al., 2016), and fertility choices (Cremer et al., 2011). In many traditional societies, families play a crucial role in old-age support (Becker, 1981; Barczyk and Kredler, 2018; Byrne et al., 2009). The introduction of pension programs can significantly shift intra-household resource allocation by reducing the need for child-provided eldercare, which in turn affects child investment and fertility. Such programs can be powerful agents of change, reshaping both family dynamics and the economy (Becker, 1981; Bau, 2021; Danzer and Zyska, 2022), with impacts varying based on local traditions and norms. This study uses the staggered introduction of the New Rural Pension Scheme (NRPS) to examine how a modern pension program alters eldercare and social norms in rural China.

In rural China, eldercare has traditionally been provided by family members, with adult children – particularly sons – playing a primary role in supporting their elderly parents. Due to low incomes and limited savings, elderly individuals rely heavily on their children for care. Among rural elderly aged 60 or older, average annual labor income is just 1870 yuan, and savings average 3740 yuan.[1] Sons are expected to provide most of the care, with married sons and their wives co-residing with parents, while married daughters typically move out. Approximately 29.9% of elderly individuals live with their sons, but only 5.0% live with their daughters. This patrilocal eldercare mode is reinforced by high brideprice paid by grooms' parents as a means of securing eldercare services through daughters-in-law, compared to lower dowries (22,881 yuan vs. 13,296 yuan).[2] These practices contribute to a strong son preference and a skewed sex ratio at birth, which reached 117.6 males per 100 females in rural China in 2015.[3]

To explore the potential effects of a pension program on this traditional eldercare mode and related social norms, we develop a conceptual framework based on the rural Chinese setting that features parents' exchange motive. In this model, parents can invest in the

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[1] Data source: CHARLS 2011–2015.
[2] Data source: CHARLS 2015; the sample is restricted to marriages during 2000–2015.
[3] Data source: 2015 mini census.

pension program and/or in their children to finance their eldercare. The introduction of a pension program is expected to reduce the need for eldercare provided by children, which may crowd out parental investment in children. Assuming that investment in a son has a higher return than investment in a daughter, we find that the introduction of a new pension program can weaken the son preference because it provides another channel through which people can prepare for old age. Using data from CHARLS 2011–2015, we show that a high brideprice is associated with a high likelihood that sons will co-reside with parents and provide physical help to parents, whereas dowry does not have a significant association with the eldercare provided by daughters. Therefore, the model predicts that a pension program will have the following effects: (i) a more significant reduction in eldercare provided by sons than by daughters, (ii) a larger reduction in investments in sons than in daughters, and (iii) a lower sex ratio of newborn.

The staggered county-by-county rollout of NRPS provides a quasi-experimental setting that allows for valid identification of the program's effects. The first round of pilot counties adopted the NRPS in 2009, followed by the second round in 2010, and the remaining two rounds in 2011 and 2012. During the rollout period of 2009–2012, the basic pension benefit for people aged 60 years and above was 660 yuan (US$110) per year, regardless of previous earnings or income. This basic pension benefit accounted for 28% of the median per capita income of rural households and was more than the income of 8% of senior citizens. People younger than 60 years can also participate in the NRPS but are not yet eligible to receive the benefits. The NRPS increased not only the current income of elderly individuals aged above 60 but also the expected lifetime income for all individuals. Therefore, we expect the NRPS to potentially affect a series of decisions related to eldercare for individuals at different stages of the life cycle.

To estimate the program's potential impacts quantitatively, we use a triple-difference (DDD) estimation approach, leveraging the staggered rollout of NRPS and employing urban individuals as a control group. Since NRPS primarily targets rural residents, we expect little effect on urban samples. The DDD framework helps address concerns regarding the endogenous timing of NRPS implementation across counties, allowing us to control for differences in baseline trends. Additionally, we supplement this analysis with a difference-in-differences (DD) estimation to provide further evidence of NRPS effects.

Using three waves of data from the China Health and Retirement Longitudinal Studies (CHARLS 2011, 2013, and 2015) and four waves of data from the China Family Panel Study (CFPS 2010, 2012, 2014, and 2016), we first analyze the effect of NRPS on eldercare arrangements for elderly individuals. By integrating these datasets, we can effectively capture variations in the timing of NRPS implementation across counties. The combined data allows us to examine changes in eldercare modes – such as co-residence and physical assistance provided by adult children, especially sons – offering a comprehensive analysis of the impact of NRPS on traditional family dynamics in rural China. Our results show that NRPS reduces the likelihood that a married son co-resides with his parents by 5.2 percentage points (17.8%) and decreases the likelihood of him providing physical help by 6.0 percentage points (42.0%), with no significant changes observed for married daughters.

Using retrospective data from CHARLS 2015, which captures parental transfers made at the time of children's marriages, we examine brideprice and dowry as proxies for parental investment in children. This data allows us to explore how marital transfers function as an exchange for eldercare support. Our findings indicate that the NRPS has sex-asymmetric effects on these transfers. Specifically, the pension program reduces the brideprice paid by sons' parents by 55.4%, but does not significantly affect dowry. This result supports the prediction that parental investment in sons, which traditionally secures eldercare services, is reduced when a public pension is available, while dowry practices, which are less tied to eldercare, remain largely unaffected.

Finally, we use micro-level data from the 2015 Chinese mini census to analyze the effect of NRPS on the sex ratio of newborns as a measure of parental son preference. In contrast to Danzer and Zyska (2022), we do not find any evidence that NRPS affected the number of newborns in China, likely due to the strict fertility limitations imposed by the One-Child Policy. However, we find that NRPS has increased the probability of a newborn being female by 2.8 percentage points, equivalent to a 12.7 percentage point reduction in the sex ratio. Additionally, we find no significant evidence that NRPS influences marital patterns, such as who marries and when, or fertility rates, suggesting that the changes in brideprice and sex ratio are not driven by self-selection.

We conduct a series of robustness checks for the above results. First, we perform separate DD analyses for rural and urban samples to verify that the observed effects of the NRPS are predominantly driven by changes in rural areas. In rural regions, the NRPS leads to significant reductions in co-residence and physical help provided by married sons, a sizable drop in the brideprice provided to sons, and an increase in the likelihood of female births. These findings are consistent with our DDD results. In urban areas, where the NRPS does not apply, no significant effects are observed on eldercare, marital transfers, or the sex ratio, strengthening the reliability of our rural-focused analysis.

Next, we implement an event study analysis to test the parallel trends assumption and to explore the dynamic effects of the NRPS over time. The event study results reveal no significant differences in pre-treatment trends across counties, confirming the parallel trends assumption. Post-implementation, the effects on brideprice and the sex ratio remain significant and persistent in rural areas, lasting several years, with no comparable effects in urban areas. These results reinforce the robustness of our findings and demonstrate the long-term implications of NRPS for family practices in rural China.

Finally, although the consistency of the DDD, DD, and event study results mitigates concerns regarding staggered adoption designs, we also address potential issues of negative weights in staggered DD estimations using alternative estimands (De Chaisemartin and d'Haultfoeuille, 2020). These alternative approaches confirm that our baseline results are robust, further validating the significant impact of the NRPS on eldercare arrangements, marital transfers, and son preference in rural China.

Our results provide a coherent story that aligns with the three predictions of our model. We conclude that a pension program can impact eldercare arrangements and social norms related to family decisions at different times. Specifically, the pension program reduces the likelihood of aging parents co-residing with and receiving care from their sons; it also decreases the investment in sons from middle-aged parents by providing less brideprice when their sons marry; and it further reduces the incentive for young parents to use sex selection technology, resulting in a lower probability of having a male child. In summary, we offer three pieces of evidence that collectively demonstrate how a pension program can change cultural practices by influencing traditional eldercare norms and investment in children.

Our study makes a significant contribution to the existing research on the impacts of pension programs. By exploring various outcomes related to eldercare and social norms across different life stages of rural Chinese residents, this research enriches the expanding literature on the effects of social pensions in developing nations (Ardington et al., 2009; Case and Deaton, 1998, and Duflo, 2000), while also complementing studies on pension reforms in developed countries (Bitler et al., 2005; Madrian and Shea, 2001, and Snyder and Evans, 2006). Notably, Attanasio and Brugiavini (2003) and Feng et al. (2011) have demonstrated that a decrease in pension wealth can elevate the saving rates of young adults. Additionally, Jensen (2004) and Juarez (2009) find that pension programs lead to a reduction in private transfers from children. Our study contributes to the literature by delving into the gender-specific effects of pensions on eldercare arrangements.

Our findings also make a valuable contribution to the growing literature on the influence of pensions on cultural outcomes. In particular, Bau (2021) shows that pension policies reduce daughters'

post-marriage co-residence with parents and educational investment in daughters in traditionally matrilocal groups in Indonesia, and reduce sons' post-marriage co-residence with parents and educational investment in sons in traditionally patrilocal ethnic groups in Ghana. Leveraging the NRPS as a quasi-experiment, our research demonstrates that this pension program also reduces the eldercare provided by sons and investments in sons (as evidenced through marital transfers and the sex of newborns) in China, a society characterized by patrilocality.

Furthermore, our study adds to the emerging body of research on pension programs in China. Huang and Zhang (2021) primarily focuses on the direct effects of the NRPS on the elderly population. Park and Shan (2020) shows that the NRPS can impact financial transfers from and educational investments in male and female children deferentially. Additionally, studies by Ebenstein and Leung (2010) and Zhang (2015) highlight that the Old Rural Pension Scheme (ORPS) in China can reduce the sex ratio at birth. By focusing on the exchange motive and investigating a wider array of family outcomes, including co-residence, physical help, marital transfer, and sex ratio, our research provides novel insights into how public pension programs can shift social norms and affect long-standing cultural preferences.[4]

Our study is also related to the literature on gender differences. For example, our findings provide a new explanation for the difference between brideprice and dowry from the perspective of eldercare mode. Our work differs from most previous studies, in which brideprice and dowry were considered pecuniary transfers to clear the marriage market (see Becker, 1981 and its follow-up studies).[5] Our findings provide a new explanation for why brideprice is much larger than dowry in China. Parents use brideprice as an investment in return for the eldercare service provided by sons and daughter-in-laws, while dowry does not serve as an investment in the eldercare provided by daughters.

Additionally, we add to the literature on the biased sex ratio in Asian countries (Rosenzweig and Schultz, 1982; Sen, 1990; Edlund, 1999; Gupta, 2005; Oster, 2005; Anderson, 2007; Qian, 2008; Chen et al., 2013; Sun and Zhao, 2016; Alfano, 2017; Jayachandran, 2017; Hong Chew et al., 2018; Almond et al., 2019) by providing new empirical evidence suggesting that the unbalanced sex ratio could have resulted from the social norm of relying on sons for old-age support.[6]

The remainder of the paper proceeds as follows. Section 2 provides background information on the NRPS. Section 3 develops a life cycle model with a series of decisions related to eldercare modes. Section 4 presents an introduction to the data, and Section 5 gives a discussion of the empirical specifications. Section 6 provides the empirical results, including robustness checks. The last section concludes the study.

2. Background

2.1. The new rural pension scheme

In rural China, the traditional provision of support to elderly people by family members has faced serious challenges due to the fertility

restrictions first imposed in the 1970s. Millions of elderly people in rural China suffer from a lack of support, and this problem has been exacerbated by the migration of many young rural people to cities since the early 2000s. According to a recent online survey, 35.4% of respondents consider "rearing the old" to be the most important problem affecting rural China.[7]

The Chinese government first implemented the social pension program, which is now known as NRPS, in rural areas in 2009. The original plan was to achieve national coverage by 2020,[8] but the NRPS developed rapidly and achieved universal coverage by the end of 2012 after four rounds of expansion. Several reasons account for the quick expansion, and these include the strong financial support from the central government to the less-developed regions, the high level of pension benefits that are attractive to rural residents, and an important policy to deal with the aging problem in rural China. Moreover, the NRPS served as a main political achievement of Premier Wen, who wanted to accomplish full coverage within his term (2003–2013). Therefore, the introduction of NRPS to each county is largely unexpected for rural residents. Data on the timing of NRPS coverage across various counties are available from China's State Council Leading Group Office of Poverty Alleviation and Development (also used in Huang and Zhang, 2021). Figs. 1(a)–1(d) show the counties in mainland China that were covered by the NRPS from 2009 to 2012.[9] Appendix B.1 provides more discussions about the choice of pilot counties. In this study, we exploit this county-by-county rollout of NRPS to identify the effects of the new pension scheme provision.

Once a county is covered by the NRPS, all rural individuals aged 16 years and older (excluding students) have the option to voluntarily participate in the program. To be eligible for pension benefits, program enrollees aged 45 years and older must continuously pay premiums until they reach 60 years of age. Enrollees younger than 45 years must continuously pay premiums for at least 15 years before they can claim any pension benefit. Participants can choose to contribute 100, 200, 300, 400, or 500 RMB annually. Enrollees aged 60 years or older at the start of NRPS are not required to pay premiums and are eligible to receive the basic pension benefit immediately.

The pension benefits come from two sources: the accumulated fund in the individual's account and the basic pension benefit.[10] To receive the pension benefit, rural residents only need to meet the age eligibility criterion, which is being at least 60 years old. The basic pension benefit amounts to 55 RMB per month (approximately 9 USD), regardless of participants' previous earnings or income. In China, the median income per capita for rural households is 200 yuan per month in 2010, and thus the basic pension benefit (55 yuan per month) is 28 percent of the median income. Appendix Figure B2 shows the distribution of the logarithm of household income per capita in rural China in 2010. For households with extremely low income (around 8 percent), the increase in household income could be over 100 percent because of the additional 55 yuan. In 2014, this benefit increased to 75 RMB per month. Therefore, the size of the pension is economically significant given that the elderly in rural China have low incomes. Moreover, participants can also receive pension from the accumulated pension fund in their individual accounts, and some may receive much higher pensions than the basic benefit.

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[4] Please refer to Appendix A for a detailed comparison of the approaches and findings between our study and previous works on pension programs in China.

[5] Refer to Anderson (2007) for a detailed summary of such literature. Zhang and Chan (1999) and Brown (2009) argued that a dowry can enhance the bargaining power of the bride. Ashraf et al. (2020) showed that the brideprice custom provides an incentive for parents to invest in their daughters' education.

[6] In the Chinese context, Li et al. (2011) and Ebenstein (2010) showed a causal link between the "missing girls" phenomenon and enforcement of the one-child policy. Chen et al. (2013) found that access to ultrasound examinations facilitates prenatal sex selection. In addition to the fertility policy, Almond et al. (2019) found that land reform increases the sex ratio, possibly through the income channel.

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[7] Source: http://toutiao.com/i6243882674679726593/ (accessed in December 2020).

[8] Source: http://www.gov.cn/zwgk/2009-09/04/content_1409216.htm.

[9] Approximately 11% of all counties ($N = 320$) were covered in the first wave (2009), and 16% (450 counties) were covered in the next year (2010). Another 38% (1075 counties) joined the program in the third wave (2011), and the remaining counties (35%, 983 counties) were covered in the last wave (2012).

[10] The interest rates of the accumulated fund fluctuate over time and vary across regions. The average interest rates from 2018–2023 is 3.3%.

(a) First round, November 2009

(b) Second round: July–October 2010

(c) Third round, July–September 2011

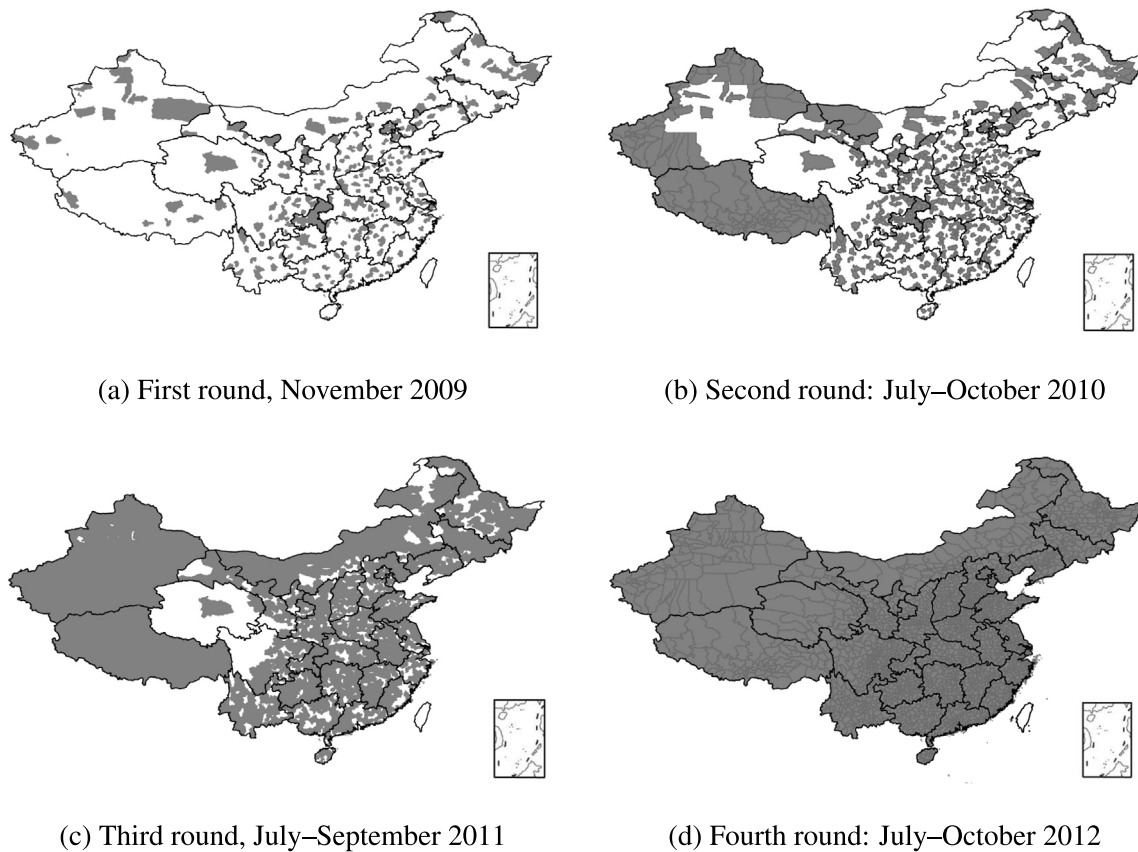(d) Fourth round: July–October 2012

Fig. 1. County-by-county rollout of the New Rural Pension Scheme over time.
Notes: This figure demonstrates the county-by-county rollout and systematic implementation of the New Rural Pension Scheme from 2009 to 2012. The figure is a schematic representation and does not depict a real map.

The basic pension benefit is similar to a defined benefit plan but with no work limits. The pension benefit is eligible to all participates aged above 60 and they do not need to retire to claim the benefit. However, it differs from the usual defined benefit pension plans because it is fully sponsored by the government, rather than employers. The basic pension benefit also differs from government-sponsored social welfare programs, which are usually means-tested. Rather, the benefit is similar to the universal basic income programs discussed in Hanna and Olken (2018). The government is responsible for making investment decisions and managing the plan's investments; it guarantees a rate of return that equals the one-year time deposit rate for the annual deposit.

By the end of 2012, the central and local governments in China had contributed more than 262 billion RMB (approximately 41 billion USD) to the NRPS; more than 232 billion RMB (approximately 37 billion USD) was contributed by the central government. In 2012, 89 million rural seniors began to receive a pension. By the end of 2014, the number of pensioners had increased to 140 million, and the total number of rural participants was approximately 426 million.

2.2. The social norm of eldercare in China

In China, especially in rural areas, sons (and daughters-in-law) bear the major responsibility of providing old-age support to the elderly. In 2015, 34.4% of rural males co-resided with their elderly parents, compared to only 5.5% of rural females, according to CHARLS 2015. Similarly, rural males (and their wives) were more likely to provide physical care to their parents (20.4% compared to 11.0% for females). These results suggest that, despite societal changes, sons still bear a disproportionate share of caregiving responsibilities in rural areas.

Moreover, sons contribute more financially to their parents than daughters and are perceived as the primary source of future support

by their elderly parents. For instance, in 2015, rural sons provided an average annual transfer of 2100 yuan to their parents, compared to 1500 yuan from rural daughters. Furthermore, when elderly parents were asked about their future support expectations, they were more likely to rely on sons for future support (50% for sons vs. 40% for daughters).

Taken together, the evidence on physical and monetary support indicates that despite significant societal changes in China over the past decade, a social norm persists in which sons continue to play a central role in eldercare, particularly in rural areas. Our findings are in line with the existing literature, including studies by Guo et al. (2022) and glu and Zhao (2018).

3. Conceptual framework

In this section, we present a conceptual framework that captures parental decisions regarding sex selection, parental transfers to children, and eldercare modes. We compare the responses of individuals who participated and did not participate in a pension program.

We assume that households live for three periods. In the first period, parents decide whether to use sex selection technology to determine the sex of their newborn. In the second period, which corresponds to the time of a child's marriage, parents can make two investments to secure old-age support. One is the marital payments to their children, and the other is the pension investment.[11] In the last period, parents receive eldercare provided by their children and pension benefits. It

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[11] Another potential avenue for investing in children is through education. However, Park and Shan (2020) finds that the NRPS leads to a decrease in parents' educational investment in daughters but an increase in their

Table 1
Summary statistics.

	Rural			Urban		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
Panel A: CHARLS & CFPS						
Parent sample						
Age (years)	89,229	69.242	7.718	53,598	69.897	8.175
Education (years)	89,229	4.629	3.689	53,598	6.651	4.475
Number of children	89,229	3.929	1.603	53,598	3.355	1.609
Child sample						
Male	89,229	0.548	0.498	53,598	0.534	0.500
Age (years)	89,229	39.712	7.843	53,598	40.518	8.323
Education (years)	89,229	7.061	4.051	53,598	9.900	4.154
Whether married	89,229	0.940	0.237	53,598	0.931	0.253
Whether co-resides with parents in the same home	89,229	0.186	0.389	53,598	0.223	0.416
Male child	48,883	0.299	0.458	28,623	0.329	0.470
Female child	40,346	0.050	0.217	24,975	0.101	0.302
Panel B: CHARLS						
Whether the child provides physical help to parents	21,321	0.107	0.310	11,019	0.122	0.327
Male child	12,317	0.141	0.348	6,055	0.143	0.350
Female child	9,004	0.062	0.241	4,964	0.097	0.296
Value of brideprice (RMB)	1,672	22,881	23,066	885	25,025	25,528
Value of dowry (RMB)	883	13,296	16,991	578	18,253	21,905
Panel C: 2015 mini census						
Female (Yes = 1)	79,237	0.454	0.498	114,828	0.462	0.499
Han ethnicity	79,237	0.869	0.337	114,828	0.881	0.324
Parent's age (years)	79,237	33.269	5.870	114,828	33.405	5.654
Parent's education (years)	79,237	9.282	2.145	114,828	10.604	2.987
First birth	78,840	0.524	0.499	114,187	0.616	0.486
Second birth	78,840	0.382	0.486	114,187	0.314	0.464

Notes: Panel A uses data from CHARLS & CFPS 2010–2016 and restricts the sample to rural/urban adult children with parents aged above 55. Panel B uses data from CHARLS 2015 and restricts the sample to rural/urban adult children with parents were aged above 55. Panel C uses data from 2015 mini census micro-level data and restricts the sample to rural/urban children born between 2005 and 2015.

is noteworthy that the eldercare provided by children increases with parental transfer.

In a patrilocal society like China, sons are primarily responsible for taking care of elderly parents. As shown in Table 1, 29.9% of male adult children live with their parents, while only 5.0% of female adult children do so. Consequently, the return to parental transfer on eldercare could differ between children's gender. Specifically, parental transfer at the son's marriage (brideprice) is strongly correlated with the eldercare provided, whereas that at the daughter's marriage (dowry) has little impact on eldercare. Appendix Table E1 examines the correlation between parental transfer at marriage and eldercare services provided by children, using data from CHARLS and CFPS (2010–2016). The analysis controls for county fixed effects, year fixed effects, parents' income, education, and age, as well as children's education and age. The results show that a 1% increase in parental transfer to sons at their marriage is linked to a 2.9 percentage point increase in the likelihood that a son will live with his parents and a 3.0 percentage point increase in the chance that the son will provide physical help to his parents. In contrast, parental transfer to daughters does not have a significant relationship with the likelihood that a daughter will co-reside with or provide physical help to her parents. Therefore, empirical evidence suggests that parental transfer to sons yields a much higher return in terms of eldercare compared to transfer to daughters.[12]

In cases where the pension is not an available option, parents have to rely on their adult son's family when they get old in the third period. In exchange, they invest in brideprice in the second period. Additionally, they are inclined to use sex selection technology to increase the likelihood of having male newborns in the first period, ensuring their chances of receiving eldercare in the third period.

Once the pension scheme becomes available, it has several effects on the eldercare provided by children. Firstly, the pension program serves as an income transfer for those already older than 60. Since wealthier parents can buy more formal care, pension reduces the eldercare provided by children. Secondly, the pension program serves as a new saving tool that reduces the need for consumption smoothing through a marital transfer. The pension program offers an immediate alternative use of money instead of paying a brideprice, thereby increasing the opportunity cost of such transfers. As a result, the amount of parental transfer at the time of a child's marriage decreases, and accordingly, the provision of eldercare services by that child also decreases.

Moreover, as we find that brideprice is highly correlated with the eldercare provided by sons, while dowry does not affect the eldercare provided by daughters, the provision of pensions will mainly reduce brideprice but not dowry. Consequently, the pension will have a larger crowding-out effect on the eldercare provided by sons compared to daughters.

Lastly, the pension program provides an alternative investment tool to smooth consumption for parents. Therefore, the advantage of having a son to secure old-age support is weakened by the pension program. In other words, the parents of sons obtain less benefit from using brideprice to "purchase" eldercare services. As a result, parents are less likely to use sex selection technology when they plan to have a baby and the sex ratio declines.

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investment in sons. They argue that this outcome is probably driven by the altruistic motive, where parents exhibit a stronger preference for sons over daughters. In contrast, our model focuses on the exchange motive and predicts that the NRPS will reduce the educational investment in sons but not for daughters, and as such, we choose not to incorporate education investment in our analysis.

[12] Anticipation of inheritance could also influence a son's decision to provide eldercare. However, for the elderly aged above 60 in rural China, the average annual labor income is just 1870 yuan, and average savings are 3740 yuan. Given the very low income and savings of the rural elderly, the bequest motive is unlikely to be a major driving force for eldercare. Additionally, we have

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controlled for parents' education and income in the regression to account for the bequest motive. While the positive correlation between brideprice and eldercare persists, we acknowledge that this finding is suggestive rather than definitive.

We formalize the intuition in a three-period model, the details of which are shown in Appendix C. The conceptual framework generates three testable predictions, as follows:

- Hypothesis 1 (Period 3): The pension scheme reduces the eldercare provided by sons more than that provided by daughters.
- Hypothesis 2 (Period 2): The pension scheme reduces brideprice to a greater extent than dowry.
- Hypothesis 3 (Period 1): The pension scheme increases the likelihood that a newborn will be female.

In the following sections, we will test these three predictions one by one.

4. Data

4.1. CHARLS and CFPS

In the first part of the analysis, we use data from the China Family Panel Studies (CFPS) and the China Health and Retirement Longitudinal Studies (CHARLS) to analyze the effect of NRPS on the eldercare mode.

CHARLS is a biennial survey that aims to follow a nationally representative sample of Chinese residents aged 45 years and older. It was designed as the Chinese equivalent of the United States Health and Retirement Survey. The baseline national wave of CHARLS was fielded in 2011, and sampled approximately 10,000 households and 17,500 individuals in 150 counties and districts. CHARLS contains information on the demographics, family structures, incomes, transfers, pension program enrollment status, health status, and eldercare modes of elderly people in China. Moreover, CHARLS collects basic demographic information on all children of the participants and records whether they co-reside with their parents and provide time and financial support to their parents.

CFPS is a nationally representative biennial longitudinal survey of Chinese families and individuals. It was designed as the Chinese equivalent of the United States Panel Study of Income Dynamics. The first national wave of CFPS was conducted in 2010, during which 15,000 households and 33,600 individuals in 162 counties and districts were sampled. CFPS contains information on the demographics, family structures, incomes, pension program enrollment, and eldercare mode (if applicable) of each family member living in a surveyed household.[13] For non-co-residing family members (e.g., non-co-residing children), CFPS still provides basic demographic information through a family relationship map. This map allows us to observe the co-residence arrangements made between parents and all of their children.

This study uses data from the 2011, 2013, and 2015 waves of CHARLS and from the 2010, 2012, 2014, and 2016 waves of CFPS. To exploit effectively the regional and temporal variations in NRPS expansion from 2009 to 2012, we pool CFPS and CHARLS data to yield a large sample. For the pooling to work, we double check the way the two surveys collect information on the dependent and independent variables, including co-residence arrangement and the education and age of parents and children, to ensure that they are identical.[14] CFPS and CHARLS cover 162 and 150 counties, respectively, and only 5 counties are covered by both. The main sample comprises 142,827 individual-year observations (i.e., 78,620 from CFPS and 64,207 from CHARLS), which we construct by linking 16,304 parents with 29,993 children. In the sample, only 19% of counties were covered by the NRPS in 2010; this proportion increased to 31% in 2011 and 69% in 2012. All counties were covered at the time of the 2013 survey.

The descriptive statistics of the sample based on the combined CHARLS and CFPS data are presented in Panel A of Table 1. In the rural sample, the average ages of the parents and adult children are 69 and 39 years, respectively. Adult children are defined as children above age 18. In addition, the average education years of the parents and adult children are 4.6 and 7.1 years. Meanwhile, 54.8% of adult children are male and 94.0% are married. On average, parents have 3.9 children; 18.6% of adult children co-reside with their parents but the likelihood differs largely by gender. The co-residence rate is 29.9% for male children and only 5.0% for female children. In the urban sample, the average ages of the parents and adult children are 70 and 41 years, and the average education years are 6.7 and 9.9 years. The likelihood that adult sons co-reside with parents is 32.9%, while the likelihood is only 10.1% for adult daughters.

We further use CHARLS data to analyze the effect of NRPS on the provision of physical help from children, because such information is unavailable from CFPS data. The CHARLS first asks whether parents need help in basic activities and daily activities.[15] For those people who need help, it further asks who (spouse, children, relative, neighbor, others) provide help. The descriptive statistics are shown in Panel B of Table 1. The physical help provider question is only applicable to parents who need help (70.8% of the elderly), so the number of observations is smaller than that for co-residence. We find that on average, 10.7% of rural adult children in the sample provide physical help to their parents in need of help; 14.1% of the male children provide help to their parents, but only 6.2% of the female children do so. Altogether, the result suggests that sons mainly bear the responsibility of caring for their parents.

In addition, we use CHARLS 2015 data to obtain retrospective information on the parental transfers paid at the times of the children's marriages.[16] In China, the transfer from the groom's parents is called brideprice, which is usually paid to the bride's parents; the transfer from the bride's parents is called dowry, which is usually paid to the child couple. During 2000–2015, 1672 marriages with brideprice information and 883 marriages with dowry information in the rural area were recorded. The average brideprice was approximately 22,881 RMB, and the average dowry value was 13,296 RMB. In most cases, brideprice is received by bride's parents, while dowry is received by the young couple. Brideprice serves as a means of purchasing eldercare service to be provided by daughter-in-laws and dowry is used to increase the bargaining power of the bride in the young couple (Zhang and Chan, 1999 and Brown, 2009).

4.2. Chinese census

The third part of our analysis uses micro-level data from the 2015 mini census to conduct an analysis related to the sex ratio of newborns.[17] The census collects basic information on individuals and households, such as demographics and the statuses of migration, marriage,

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[13] The eldercare mode questions in CFPS are similar to those in CHARLS, except that CFPS data do not distinguish which children provide eldercare.

[14] The pooled sample is only used to analyze the effect of NRPS on the co-residence arrangements between parents and adult children. Co-residence is defined as living in the same household for CFPS and CHARLS.

[15] Basic activities include jogging 1 km, walking 1 km, walking 100 m, getting up from a chair after sitting for a long period, climbing several floors, stooping, kneeling or crouching, reaching or extending arms above shoulder level, carrying weights over 10 jin, and picking up a small coin from a table. Daily activities include dressing, bathing, eating, getting into or out of bed, using toilet, controlling urination and defecation, doing household chores, cooking, shopping, making phone calls, taking medications, and managing money.

[16] CFPS only provides information on the parental transfers from the bride's parents, not those from the groom's parents.

[17] Every 10 years (e.g., 1990, 2000, and 2010), China conducts a national population census; in the middle of every 10-year period (e.g., 1995, 2005, and 2015), China also conducts a mini census that samples 1 percent of the national population. By using a multi-stage probability sampling method, each census and mini census draws a nationally representative sample that covers 31 provinces and municipalities in China.

and fertility.[18] Panel C of Table 1 presents the summary statistics on the sex ratio and birth order from the 2015 mini census. Among rural children born between 2005 and 2015, only 45.4% were female, suggesting a biased sex ratio of 1.20 males per female. Around 52%, 38%, and 10% of the newborns were first, second, and higher-order births, respectively.

5. Empirical specification

Our empirical analysis tests the three predictions generated by our model. In particular, we utilize the rollout design of NRPS to explore the differences between counties that implemented the NRPS earlier and those that implemented it later. Furthermore, as the reform only benefits rural individuals, we consider the rural sample as the treatment group and the urban sample as the control group. We conduct a triple-difference estimation and various robustness checks.

5.1. Triple-difference estimation

The triple-difference estimation relies on the rollout of NRPS across counties. However, the pilot counties may differ from other counties in certain aspects, which could pose a problem if the pilot counties also exhibit different trends in the examined outcomes. In Appendix Table E2, we demonstrate that counties in the final wave are more economically developed than those in earlier waves.[19] Nevertheless, we show that prior to 2009, counties with different NRPS implementation years had comparable trends in terms of a range of macroeconomic indicators, such as GDP per capita, Salary, Population, as well as the number of primary school, high school, and college students, as illustrated in Appendix Figures E1 and E2.

To further address concerns regarding differential trends, we employ urban individuals as a control group in the triple-difference estimation. In China, social insurance and welfare programs are linked to the *hukou* system, which assigns benefits based on rural and urban *hukou* status. In the early 1990s, the Chinese government established an urban old-age security system with a high coverage rate and generous payment. This system is independent of the NRPS and uses a combination of pay-as-you-go and funded systems. During the years when the NRPS was being rolled out, there were no significant changes made to the pension policy in urban China, and pension benefits continued to rise steadily throughout the country. Since the NRPS targets rural residents, we expect it to have little impact on the urban sample since those with an urban *hukou* are ineligible to participate.

The DDD estimation incorporates an additional comparison between rural and urban individuals, which has the added benefit of eliminating county-specific shocks that coincide with the introduction of NRPS. By using the DDD approach, we address concerns that the NRPS may have been rolled out endogenously across counties, and that counties implementing the NRPS earlier may have had distinct trends in the outcome variable.

We have two sets of triple-difference (DDD) equations. In the first set of DDD regressions, we use instantaneous responses as dependent variables, including whether adult children live with their parents and whether adult children provide physical help to their parents in the survey year. In this case, t represents the survey year and $NRPS_{tc}$ equals 1 if the scheme was introduced to county c during or before the

survey year t. The DDD specification compares the treatment effects between the rural and urban samples:

$$y_{itc} = \beta NRPS_{tc} \times R_i + \gamma X_{itc} + \eta_{tr} + \eta_{cr} + \psi_{itc}, \tag{1}$$

where R_i is a region indicator, that equals one if living in rural areas and zero if living in urban areas. Since there exist rural and urban regions within each county, the interaction of $NRPS_{tc}$ and R_i demonstrates the effect of NRPS on rural residents compared with urban residents.[20] We control for individual demographic characteristics (X_{itc}), county by region fixed effects (η_{cr}), and survey year by region fixed effects (η_{tr}).

In the second set of DDD regressions, we use retrospective events as dependent variables, including the logarithm of brideprice and dowry transferred to children married in year t and an indicator of whether a baby born in year t is female. The regression model is still the same as Eq. (1), but t represents the event year, i.e., marital year or birth year. The key independent variable, $NRPS_{tc} = 1$, if the scheme was introduced to county c during or before the event year t.[21] η_{tr} represents event year by region fixed effects instead of survey year by region fixed effects.

We employ the Ordinary Least Squares Model (OLS) when the dependent variable is continuous (i.e., martial transfer), and the Linear Probability Model (LPM) when the dependent variable is a binary variable (i.e., co-residence, physical help, and sex of newborn). In the regressions on co-residence arrangement, physical help, and marital transfer, demographic controls consist of the education level and age of parents and adult children.[22] Furthermore, we conduct separate regressions for sons and daughters as the model predicts that the effects of NRPS may differ by gender due to the gender-specific eldercare arrangement. In the regression on the sex of newborn, the demographic controls include parents' ethnicity, education level, and age. We cluster all standard errors at the county level.

In this study, we define the treatment group as all individuals living in counties with NRPS rather than elderly aged above 60 with NRPS. This is because the NRPS increases not only the current income for the elderly aged above 60 but also the expected lifetime income for all individuals. When individuals are forward-looking, the introduction of a pension program increases their future income and provides security to elderly life. Therefore, the decisions related to eldercare at different life stages, such as fertility decision (for young parents), transfer to children (for middle-aged parents), and eldercare service from children (for older-aged parents) can be affected. Moreover, the treatment group includes individuals not enrolled in the pension program, and hence, we estimate the intention-to-treat effect.

The identification of our study is based on the assumption that rural residents were not aware of the exact implementation time of

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[18] We link the newborn children (born between 2005 and 2015) with their parents via the revealed relationship to household head. Since these children are still young in 2015, the chance that they separate from their parents is small.

[19] Counties in the first two waves share many similarities. Counties in the third wave have lower salary, larger population size, and more students than those in the second wave. Counties in the last wave have higher per capita GDP, salary, government expenditure, and government revenue than those in the third wave.

[20] In the analysis on the sex of newborns, R_i is an indicator of whether individuals have rural *hukou*. This is a more accurate definition of treatment because the NRPS is available for all individuals with rural *hukou*, including migrants who work in the urban area. In Section 6.4, we provide more discussions related to the migration issue.

[21] When the outcome variable is the gender of the newborn, $NRPS_{ct} = 1$ if the scheme was introduced more than a half year before the birth year and $NRPS_{ct} = 0$ if the scheme was introduced more than a half year after the birth year. We remove the children born within a half year before and after NRPS implementation year because the response of fertility may exhibit a delay, because it takes nine months to give birth to a child. In the robustness check shown in the first column of Appendix Table E11, we keep the children born half year before NRPS implementation in the control group and the results remain robust.

[22] One possible concern is that children's education may be endogenous to the pension program. However, since these children were already over 18 years old when the NRPS was implemented, their education should not be affected by the pension program. Additionally, we control for children's sex when performing regressions on the entire sample.

NRPS. As explained in Section 2, the original plan of NRPS was to achieve national coverage in ten years, and the rapid expansion was largely unforeseen. Additionally, rural residents had limited access to information about what was happening in other rural counties, and many were unaware of the NRPS even after it was introduced in their home county. Therefore, we believe that any anticipation effect is relatively small in our context. Even if such an effect exists, it would lead to an underestimation of our results.

5.2. Difference-in-difference estimation

To ensure that the results of the DDD analysis are attributed to a change in the rural sample rather than the urban sample, we conducted separate difference-in-difference (DD) estimations for the two samples. The specification for these estimations is as follows:

$$y_{itc} = \alpha + \beta NRPS_{tc} + \gamma X_{itc} + \eta_t + \eta_c + \psi_{itc}, \tag{2}$$

The definition of y_{itc}, $NRPS_{tc}$, and X_{itc} are the same as in Eq. (1). We control for survey/event year fixed effects η_t and county fixed effects η_c. By estimating the rural sample, we are able to directly assess whether the NRPS affects the behavior of rural individuals. Additionally, we use the urban sample as a placebo test to investigate whether other events occurred simultaneously with NRPS rollout at the county level.

5.3. Event study approach

To further validate the parallel trend assumption in the DD and DDD estimations, we conduct event study analysis separately for our rural and urban samples. Following Duflo (2001) and Dobkin et al. (2018), we use linear two-way fixed-effect regressions with leads and lags of treatment, as shown in the following equation:

$$y_{itc} = \sum_{\substack{-4 \leq l \leq 4 \\ l \neq -1}} \beta_l D_{tc}^l + \gamma X_{itc} + \eta_t + \eta_c + \psi_{itc}, \tag{3}$$

where $D_{tc}^l = 1\{t - E_c = l\}$ is an indicator for being l years relative to county c's NRPS starting year E_c, and it varies across counties. We include 4 lags and 4 leads in the regression and normalize the effect in period $l = -1$ to be zero.[23]

Given that we do not observe the eldercare arrangement (co-residence arrangement and physical help to parents) before NRPS because CHARLS/CFPS only began in 2009/2010, we conduct the event study analysis only for marital transfer and sex ratio. For marital transfer, we set $D_{tc}^0 = 1$ when the child couple got married in NRPS implementation year. For sex ratio, we set $D_{tc}^0 = 1$ when the child was born within a half year before and after NRPS implementation time.

We also conduct the event study version of the DDD estimation (referred to as dynamic DD in Fadlon and Nielsen (2019)) by combining the rural and urban samples. We use the urban sample as the control group as follows:

$$y_{itc} = \sum_{\substack{-4 \leq l \leq 4 \\ l \neq -1}} \beta_l D_{tc}^l \times R_i + \sum_{\substack{-4 \leq l \leq 4 \\ l \neq -1}} \mu_l D_{tc}^l + \gamma X_{itc} + \eta_{tr} + \eta_{cr} + \psi_{itc}. \tag{4}$$

The interactions of D_{tc}^l and R_i demonstrate the time-varying effects of NRPS on rural residents compared with urban residents. By conducting the dynamic DD estimation, we can further control for the county-year level confounding factors and provide another set of tests in the case of unparallel pre-trends.

The event study analysis has a few merits. Firstly, the patterns of the estimates for the periods prior to NRPS implementation provide a direct test of the unparallel pre-trends between the treated and control groups. Secondly, the patterns present the results in a straightforward manner so that we can observe whether the outcomes began to change significantly in the year when NRPS started. This observation will provide indirect evidence on the validity of our estimation given a small chance of contemporary confounding factors changing the outcomes in the same manner. Thirdly, the event study results present an estimation of the effects in the following years, which enables us to observe whether the effects are persistent or not. Lastly, the event study design allows for time-varying dynamic effects, thereby alleviating the concerns caused by staggered DD.

6. Empirical results

6.1. Impact of NRPS roll-out on enrollment

Firstly, we examined the validity of the official document we used to record the NRPS roll-out across counties as a measure of NRPS implementation. To achieve this, we analyzed the effect of NRPS roll-out on self-reported enrollment rates, utilizing data from CHARLS and CFPS from 2010 to 2016. We estimated the following equation:

$$Enroll_{itc}^s = \alpha^s + \beta^s NRPS_{ct}^s + \gamma^s X_{itc} + \eta_t^s + \eta_c^s + \psi_{itc}$$

The dependent variable, $Enroll_{ict}^s$, is an indicator of whether individual i enrolled in the NRPS. The key independent variable, $NRPS_{ct}$, is an indicator of whether county c implemented the NRPS in year t, based on the official document. The covariates include survey year dummies (η_t), county dummies (η_c), and other demographic controls (X_{ict}), such as gender and education.

We divided the entire sample into subgroups s based on age and hukou eligibility. Fig. 2 presents the results for each subgroup. The findings suggest that NRPS coverage increases enrollment rates by 30% to 40% for individuals with rural hukou across different age groups (45 to 75 years old). The effects are similar between individuals younger and older than 60, although younger enrollees need to pay contributions while older ones do not. On the other hand, the NRPS roll-out had no impact on individuals with urban hukou, which supports the use of the urban sample as a control group.

It is important to note that this coefficient captures the short-term effects of the NRPS on pension enrollment. In the long run, the NRPS has a higher take-up rate. According to CHARLS data from 2015, 70.5% of elderly individuals aged 60 to 75 were enrolled in the NRPS. The take-up rate was 63.0% for individuals aged 45 to 59 and 49.4% for those aged 30 to 44. Not all elderly individuals above 60 enrolled because in some rural areas, their enrollment needed to be accompanied by the enrollment of a young adult. Additionally, some elderly individuals were not aware of the introduction of the new pension program.[24]

6.2. Impact of NRPS on eldercare, marital transfers, and sex ratio

Eldercare arrangement. We use data from CHARLS and CFPS 2010–2016 to analyze the effect of NRPS on decisions regarding the eldercare mode for aging parents. This analysis corresponds to the last period in our model. We analyze the effects of NRPS on two measures of the eldercare mode: whether adult children live with their parents, and whether adult children provide physical help to their parents.

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[23] In practice, we bin the data four years before NRPS implementation to the −4 group and bin the data four years after NRPS implementation to the +4 group to avoid the multi-collinearity problem.

[24] Appendix B.2 provides information on how the take-up rate of the NRPS program differs over time and between counties that implemented the program at different times. In the first year of implementation, the overall take-up rate was relatively low. However, it increased rapidly in the second and third years and reached 70% by the third year. This pattern was consistent across counties that implemented the NRPS program early and those that implemented it later.
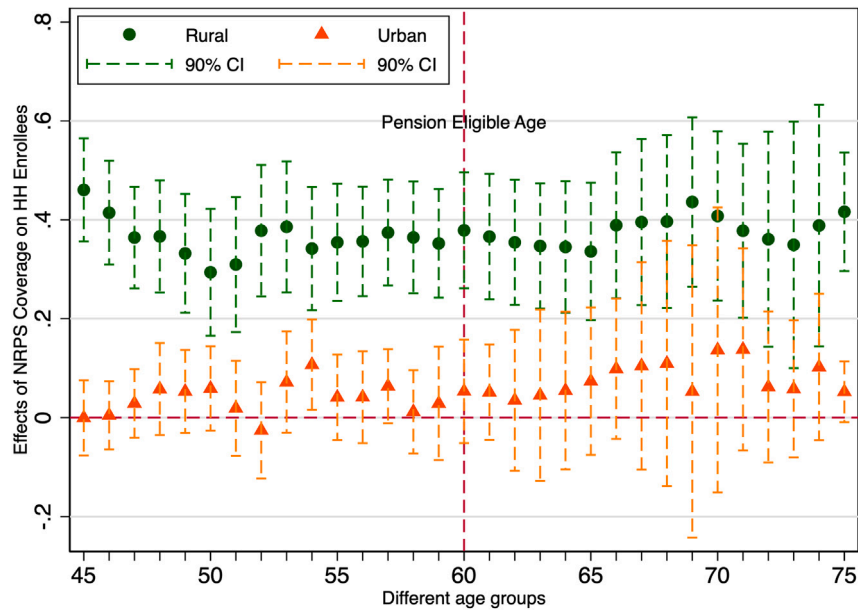
Fig. 2. Effect of NRPS roll-out on enrollment rates.
Source: CFPS and CHARLS, 2010–2013.

Table 2
Triple difference estimation — effect of NRPS on eldercare, marital transfer, and sex ratio.

A. The dependent variable is whether co-resides with parents (Yes = 1)

Sample	All	Married male	Married female	Unmarried
NRPS × Rural	−0.031*	−0.052**	−0.014	0.080
	(0.017)	(0.026)	(0.012)	(0.089)
Observations	142,827	70,793	63,018	9,016

B. The dependent variable is whether provide physical help to parents (Yes = 1)

Sample	All	Married male	Married female	Unmarried
NRPS × Rural	−0.039	−0.060*	−0.020	−0.021
	(0.024)	(0.034)	(0.031)	(0.093)
Observations	32,340	16,581	13,411	2,348

C. The dependent variable is the log parental transfer at the child's marriage

Sample	All	Married male	Married female	Unmarried
NRPS × Rural	–	−0.554**	0.199	–
	–	(0.225)	(0.354)	–
Observations	–	2,557	1,461	–

D. The dependent variable is whether the newborn is a girl (Yes = 1)

Sample	All	First birth	Second birth	Higher-order birth
NRPS × Rural	0.028**	0.034*	0.041*	−0.086
	(0.013)	(0.018)	(0.024)	(0.056)
Observations	194,065	111,543	65,700	14,416

Notes: 1. The first panel uses data from CHARLS & CFPS 2010–2016, the second panel uses data from CHARLS 2011–2015, the third panel uses data from CHARLS 2015, and the last panel uses the 2015 mini census.
2. The dependent variables in the four panels are a dummy variable indicating whether the adult child lives with the parents, a dummy variable indicating whether the child provides physical help to the parents, the log value of the parental transfer at the child's marriage, and an indicator of whether the newborn is a girl, respectively. The first two panels are restricted to a sample of rural and urban adult children whose parents aged above 55. The third panel is restricted to a sample of rural and urban adult children whose marital year is between 2000 and 2015. The last panel is restricted to rural and urban individuals born between 2005 and 2015.
3. All panels adopt the DDD model. All panels control for year × region fixed effects and county × region fixed effects. The first to third panels control for the educational level and age of parents and children. The last panel controls for parents' ethnicity, education, and age.
4. Standard errors are in parentheses and clustered at the county level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The first panel of Table 2 shows the effect of NRPS on the co-residence decisions of rural adult children. Co-residence is defined as whether an adult child lives with his/her parents in the same house. Co-residence data are available from both CHARLS 2011–2015 and CFPS 2010–2016. We restrict our sample to adult children with parents aged above 55. We follow the DDD specification in Eq. (1) and control for the characteristics of the parent and child.

Column (1) of Panel A in Table 2 shows that the introduction of NRPS led to a 3.1 ppt (15.4%) reduction in the likelihood of co-residence for all rural adult children. However, co-residence alone may not reflect eldercare pattern because young adult children may opt to co-reside with their parents to reduce their living expenses (Rosenzweig and Zhang, 2020; Dai et al., 2021). Married children are more likely to provide eldercare when living with the elderly,

and traditionally, sons bear most of the responsibility for eldercare. Therefore we divide the sample by marital status and child gender and show the results in Columns (2) and (3). We find that the effect is concentrated among married sons, whose likelihood of co-residence decreased by 5.2 ppt (17.8%) after the introduction of NRPS, but did not have a significant effect on married female children. The coefficient for sons is significantly smaller than that for daughters with a *p*-value < 0.1. In Appendix Table E3, we conduct DDD regression separately for CFPS and CHARLS datasets. The NRPS decreases the likelihood of rural married men living with parents by 3.7 percentage points in the CFPS data and 6.5 percentage points in the CHARLS data.

This sex-based asymmetry supports the model's first prediction that a pension program reduces the eldercare provided by sons to a greater extent than that provided by daughters. This is unlikely to be driven by an improvement in the health of the elderly (shown in Huang and Zhang, 2021) because this mechanism will lead to a decline in old-age support from both sons and daughters. In addition, the likelihood of co-residence did not change significantly among unmarried children. These results suggest that rural seniors received less care provided by married sons after the introduction of NRPS.

We also conduct a parallel analysis of the effect of NRPS on the physical help provided by children to obtain direct evidence on old-age support using CHARLS data, which include information on whether individual children offer daily care to their parents. Specifically, we use the data from CHARLS 2011–2015 to identify the physical help exchanged in each parent–child pair. Similar to the co-residence analysis, the sample is restricted to adult children with parents aged above 55. In addition, the sample is further restricted to parents in need of help because physical help information is only available for these parents. As shown in Appendix Table E12, we estimate the effects of NRPS on whether the parents need help following the DD specification in Eq. (2) and find no evidence that the NRPS affects the number of parents who need help.

As shown in the first column of Panel B in Table 2, the NRPS leads to a reduction in the probability that children will provide physical help to their parents, although not statistically significant. After further dividing the adult children by their marital status and child gender, we find that the effect of NRPS is concentrated on married sons, as shown in Columns (2). Specifically, the NRPS reduces the likelihood that married sons provide physical help to their parents by 6.0 ppt (42%), whereas the effect on female children is not statistically significant. This finding provides further support to the first prediction of our model that a pension program reduces the eldercare provided by sons more than that provided by daughters. Furthermore, the NRPS has no significant effect on the eldercare provided by unmarried children.

We also examined the effect of NRPS on financial transfers using the DDD model. As shown in the first four columns of Appendix Table E4, at the parent level, the pension program does not affect the likelihood of receiving any transfers from children or the amount of transfers from children. This finding is consistent with Huang and Zhang (2021). Additionally, the last four columns of Appendix Table E4 show that, at the child level, the pension program does not change the financial support children provide to their parents, for both sons and daughters.[25]

Brideprice and dowry. After examining the effect of NRPS on decisions regarding the eldercare mode for aging parents, we move on to analyze the effect of the pension scheme on parental transfers to children at the time of marriage. This analysis corresponds to the decisions made in the second period in our model. We use data from CHARLS 2015, which provides retrospective information about brideprice and dowry given

by sons' and daughters' parents, respectively. We restrict our sample to marriages that occurred between 2000 and 2015. In addition, the sample is further restricted to the married children whose parents made transfer to them at the time of marriage. More than 63% of married sons received transfer from parents at the time of marriage, and the percentage is 44% for married daughters.[26] Traditionally, parents are more likely to make marital payments to sons than daughters due to the biased sex ratio. The first two columns of Appendix Table E14 show no significant evidence for any impact of NRPS on whether parents made transfer to children at the time of marriage, which suggests that the pension program has no effect on the extensive margin.

Panel C of Table 2 presents the results of the DDD model for the effect of NRPS on the amount of marital transfer. The NRPS exerts a significantly negative effect on the brideprice given by sons' parents (Column 2) but does not affect the dowry given by daughters' parents (Column 3). For sons who were married on or after the introduction of NRPS, brideprice declined by 55.4%. This finding is consistent with our model's second prediction that a pension program reduces brideprice, but not dowry. The coefficients of brideprice and dowry are statistically significantly different with a *p*-value < 0.1.

Sex ratio. We use micro-level data from the 2015 mini census to investigate the effect of NRPS on the probability of having a female birth, which corresponds to the sex selection decision made in the first period of the model. The sample is restricted to children born between 2005 and 2015.[27]

The first column of the last panel of Table 2 presents the results of the DDD estimation for the full sample. The introduction of NRPS led to a 2.8 percentage point increase in the likelihood of a newborn being female in rural areas compared to urban areas. In 2008, the sex ratio of newborns in rural areas was 1.20 males per female, so our findings suggest that the NRPS resulted in a 12.7 percentage point (10.7 percent) decrease in the sex ratio. The magnitude of this effect is 64% of the impact observed in Almond et al. (2019), where China's land reform from 1978 to 1984 was shown to increase the sex ratio from 1.1 to 1.3 males per female among newborns (a 20 percentage point increase) within four years after the reform. Additionally, the effect size is larger than that of ORPS. Studies by Ebenstein and Leung (2010) and Zhang (2015) find that ORPS reduces the sex ratio at birth by 9 percent and 2 percentage points, respectively. This disparity is not surprising given that the NRPS has a higher take-up rate compared to ORPS (70% vs 15%).

We also investigate whether the effect of NRPS on the sex ratio varies by birth order. As shown in Columns (2) to (4) of the last panel of Table 2, the NRPS raises the probability of having a female newborn for the first and second births by 3.4 and 4.1 percentage points, respectively. However, the effect of higher-order births is insignificant. The sex ratio for the first birth in rural areas in 2008 was 1.20, and the sex ratio for the second birth was 1.28. This suggests that the NRPS decreases the sex ratio by 15.3 and 19.5 percentage points for the first and second births, respectively. Although the one-child policy in rural China permits families to have a second child if the first child is a girl, some families may not desire to have two children due to low family income and the costs of raising children. Hence, rural families may still engage in sex selection for the first birth. Our results demonstrate that the provision of a pension can decrease the sex ratio for both the first and second births, with a more pronounced effect for the second birth.

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[25] Park and Shan (2020) find that pension reduces inter-vivo transfer from sons but not daughters. This different finding could be driven by the different measures we use as mentioned in Appendix A. Nevertheless, their finding is consistent with our story — pension crowds out old-age support from sons more than daughters.

[26] Among those who reported marital payments, all of them reported non-zero values.

[27] In the 2015 mini census, an agricultural *hukou* was defined based on whether the respondent had rural land contract rights, as some provinces had eliminated the distinction between agricultural and non-agricultural *hukou*.

One potential concern is that the relaxation of one-child policy after 2010 could affect our results on sex ratio.[28] Our identification of the NRPS treatment effect relies on the county-by-county rollout. Only if the relaxation of the one-child policy has the same roll-out pattern would it be a problem. However, the one-child policy is a national movement and has been controlled by the birth year fixed effects. Moreover, during the NRPS rollout periods (2009–2013), the relaxation of the one-child policy mainly affects young couples of which both the husband and the wife are single children. In the rural area, very few young couples are qualified because most of them have siblings. Therefore, the reform of the one-child policy is unlikely to be a confounding factor.

Another concern is that China government banned the sex-selective abortion in 2003. However, Das Gupta (2019) and Xiong (2022) show that the policy is not effective because the sex ratio is still quite biased after the banning of sex-selection. This is because parents can still find other ways to discover the sex of fetus, such as bribing the doctor. In fact, using several waves of Chinese census, we show in Appendix Figure E3 that the sex ratio at birth in rural China remained quite stable after 2003 and only declined after 2009, the implementation of NRPS.

6.3. Robustness checks

6.3.1. Difference-in-difference estimation results

To demonstrate that the DDD results are driven by changes in the rural sample rather than the urban sample, we conduct separate DD estimations for each group.

In the rural sample, the implementation of NRPS leads to a 4.5 and 4.1 percentage point reduction in the likelihood of married men living with their parents and providing physical help to their parents, respectively, as shown in Panels A and B of Appendix Table E5. However, the pension program does not affect the eldercare provided by married women and unmarried children. Panel C further indicates that the pension program reduces the brideprice for sons by 28%, but has no significant effect on the dowry for daughters. Additionally, the probability of having a female birth increases by 3.2 percentage points, as shown in the last panel. In contrast, the urban sample does not exhibit any significant impacts of NRPS on co-residence, physical help, marital transfer, or sex ratio, as shown in Appendix Table E6.

6.3.2. Event study results

To verify the parallel trend assumption in both the DD and DDD models, we utilized event study analysis. Fig. 3 displays the event study results on the DD and DDD models in the left and right panels, respectively. The regression coefficients are reported in Appendix Tables E7, E8, and E9.

As depicted in Fig. 3(a), the effect of NRPS on brideprice is nearly zero for marriages in rural areas that occurred four years before the implementation of NRPS, which supports the parallel trend assumption. Moreover, we observe a significant and negative effect on brideprice for marriages in rural areas that took place during the year of NRPS implementation, and this negative effect continues for four years after the introduction of the scheme. Specifically, brideprice is reduced by 34.1% and 66.9% for sons who were married on and four years after the implementation of NRPS, respectively, compared to those married one year before its implementation. In contrast, we find no effect of NRPS on brideprice in the urban sample. None of the lags and leads are statistically significant. Fig. 3(b) further confirms that, compared

to the urban sample, the NRPS has significant effects on the brideprice of the rural sample during the year of NRPS implementation, and this effect persists for four years after implementation.

In contrast, we find no effect of NRPS on dowry before and after its implementation, as demonstrated in Figs. 3(c) and 3(d).[29] This finding confirms that the pension has a gender-asymmetric impact on marital transfers.

Figs. 3(e) and 3(f) present the results of the event study on having a female birth. Similarly, we find that none of the lagged variables are significantly different from zero, and no obvious trend is observed. The effect of NRPS on having a female child is relatively small during the year of NRPS implementation (half a year before and after the introduction of NRPS), as pregnancy lasts nine months. However, the probability of having a female child at birth increases by 2–4 percentage points between one and four years after the introduction of NRPS, compared to children born one year before its implementation.

6.3.3. Issues of staggered DD design

A few recent studies have pointed out that two-way FE regressions in the case of staggered adoption designs can be problematic when heterogeneous treatment effects exist across groups and over time (Callaway and Sant'Anna, 2021; De Chaisemartin and d'Haultfoeuille, 2020; Goodman-Bacon, 2021; Sun and Abraham, 2021). These studies have demonstrated that two-way FE regressions estimate the weighted sums of the average treatment effects in each group and period, with weights that may be negative. Therefore, we refine the DD estimates in two ways.

Firstly, we estimate the treatment effect on the pilot counties that implemented NRPS in 2009 (referred to as "first treatment"). In other words, we only consider the counties that implemented NRPS in 2009 as the treatment group, and use the counties that implemented NRPS in 2010–2012 as the control. For the control counties, we only keep the not-yet-treated observations, i.e., the periods before they implemented NRPS.[30] This allows us to avoid the negative weight problem because the "not-yet-treated" observations are not affected by the NRPS and can therefore serve as a uncontaminated control group.
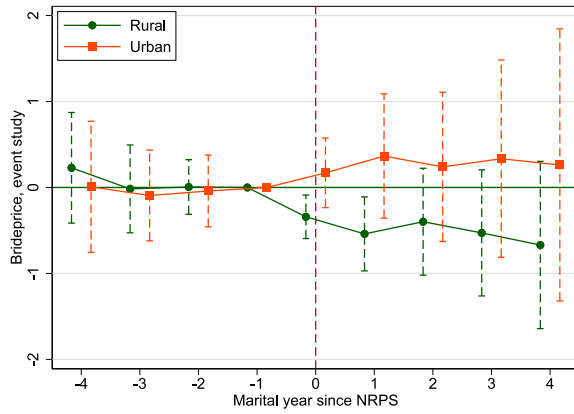
Secondly, we follow De Chaisemartin and d'Haultfoeuille (2020) and compute a new estimand by using the did_multiplegt Stata package (referred to as "CD2020"). This estimand identifies the effect of the treatment in groups that switch treatment, at the time when they switch.

We present the results on parental transfer at marriage by using the first treatment and CD2020 in Panels A and B of Appendix Table E10, respectively. The corresponding robustness checks for sex ratio are presented in the last two columns of Appendix Table E11. The results are robust when these alternative estimators are used. However, we do not have data on co-residence arrangement and physical help before NRPS treatment, so the first treatment and CD2020 cannot be applied to these two outcome variables.
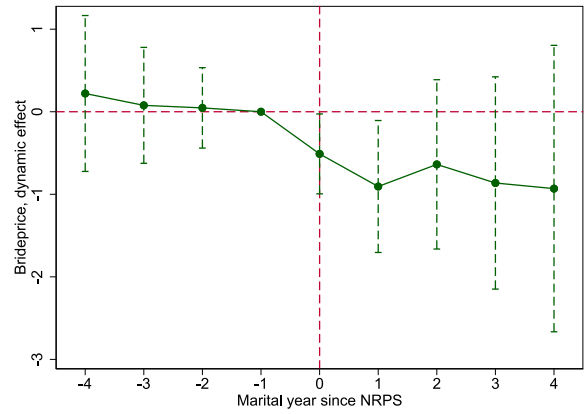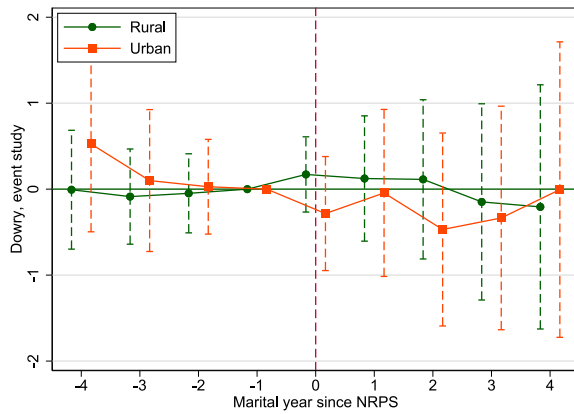
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[28] Before 2011, rural China implemented the 1.5 children policy, where families with a girl can have a second child; urban China implemented the one-child policy. Since November 2011, parents in which both the husband and the wife are single child can have two children. Starting from December 2013, parents in which one of the couple is single child can have two children. After October 2015, all families can have two children.
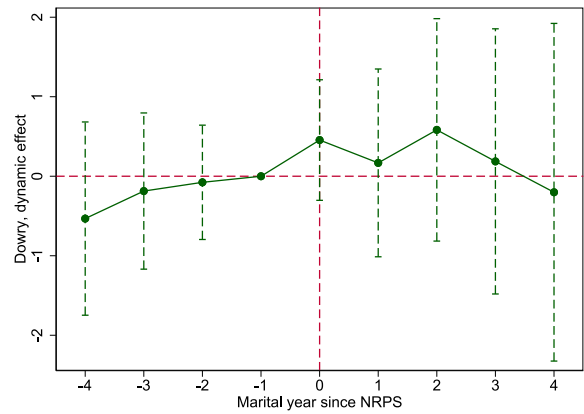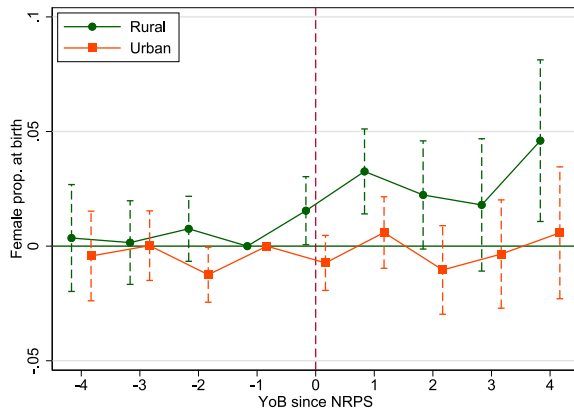
[29] Fig. 3(d) shows a weak and insignificant pretrend in dowry, which grows by approximately 20% every year. If we take this upward pretrend seriously, the effect of NRPS on dowry would be even closer to zero.

[30] Take the sex ratio analysis as an example. We retained all children from counties that implemented NRPS in 2009, and only retained children born before 2010/11/12 in counties that implemented NRPS in 2010/11/12. In this way, children from counties that implemented NRPS in 2009 are the treated group, and children from counties that implemented NRPS after 2009 are the control group. In the "first treatment" estimate, we compare the difference in the sex ratio of the aforementioned two groups before and after 2009.

Fig. 3. Effect of NRPS on marital transfer and sex ratio.

Notes: The dependent variable is the logarithm value of brideprice in Panels A and B, the logarithm value of dowry in Panels C and D, and whether the newborn is a girl in Panels E and F. Eq. (3) is estimated in Panels A, C, and E for the rural or urban sample and the coefficients of D_{ct}^l are reported. Eq. (4) is estimated in Panels B, D, and F by using the full sample and the coefficients of the interactions between R_i and D_{ct}^l are reported. The marital/birth year just before NRPS implementation is the reference group. The x axis indicates the difference between the marital/birth year and NRPS implementation year. We also report the 90% confidence interval. Panels A to D use the China Health and Retirement Longitudinal Study 2015. The sample is restricted to individuals married within six years of NRPS implementation. Panels E and F use the 2015 mini census. The sample is restricted to individuals born within five years of NRPS implementation.

6.4. Other confounding factors

Marriage decisions. We are also concerned that the NRPS may have affected the marital pattern. Corno et al. (2017) found that income shocks affect the marital age because marital payments are a source of consumption smoothing. If this result remains true for NRPS, then the effect on brideprice could have been driven by a change in the marital age, rather than a change in the eldercare mode. We use the sample of rural adult children married between 2000 and 2015 from CHARLS 2015 (same sample as that in the parental transfer analysis shown in Table E5) and aggregate the data to the number of marriages at the county-year level. We regress the number of marriages on whether the county had implemented NRPS and use the county and marital year fixed effects as the regression controls. We find no evidence that the pension program affected the number of marriages, as shown in Appendix Table E13.

We also use the same data to check whether the NRPS affected the characteristics of newly married couples. We follow the DD specification on brideprice (Eq. (2)), and instead regress the education levels and marital ages on the NRPS indicator for rural adult children married between 2000 and 2015, controlling for the county and marital year fixed effects. Again, we find no evidence that the pension program affected the education levels or marital ages of married men and women, as shown in columns (3) to (6) of Appendix Table E14. These findings suggest that the NRPS did not affect who got married and when they were married. Rather, the negative effect of NRPS on brideprice was most likely driven by a change in the eldercare mode, namely, switching from informal care provided by sons to formal care.

Fertility. Moreover, the NRPS may have affected the sex ratio through channels other than the eldercare mode. For example, the NRPS may have affected the desire of young couples for a child. Appendix Table E15 analyzes the effect of NRPS on the birth of children in rural households, including whether couples had a newborn and whether they had second- or higher-order births, during the period of 2005 to 2015. We use data from the 2015 mini census to run the same specification as that in Eq. (2). We find that the effects of NRPS on the number of newborns, as well as on second- or higher-order births, are neither economically nor statistically significant. Therefore, we find no evidence that the NRPS affects the fertility of young couples in rural areas. This is mainly because the fertility decision in China faces a binding constraint due to the fertility policy.

Migration. Another possible concern in this study is migration. All individuals with a rural *hukou*, including rural residents and migrants in urban areas, are eligible to participate in NRPS. Given that county registration data were collected in the 2015 mini census, we define the treatment status based on the registered county in our regressions on the sex ratio. However, CHARLS and CFPS data only include information about the current county of residence, but not the county of registration. We therefore define the treatment status based on whether the parent's resident county had implemented NRPS in our regressions on co-residence status, physical care, and marital transfer. If the factors that affect migration are correlated with NRPS implementation timing and the outcomes, the estimates will be biased. However, this is not a serious problem in our analysis. Firstly, among rural elderly people aged 55–85, only 3% were not living in their registered counties at the time of the survey. Secondly, Huang and Zhang (2021) showed that the NRPS does not affect the cross-county migration of elderly people.

7. Conclusions

The aging of societies in many countries is widely recognized. Given the rapid increase in the proportion of elderly citizens, many developing countries have introduced or expanded large social pension programs to cover vulnerable elderly people in inadequate eldercare markets (Willmore, 2007; Levy and Schady, 2013).[31]

This study analyzes how a pension program may affect a series of behaviors related to the eldercare mode and social norms across the lifecycle by exploiting the introduction of NRPS in rural China. We use the county-by-county rollout of NRPS and employ urban individuals as a control group to identify the causal effect of the pension program. Firstly, we find that in the counties that have implemented NRPS, children are less likely to live with or provide physical help to their parents, especially after marriage. In addition, these negative effects on co-residence and physical help are mainly observed among married male children, but not married female children. Our findings imply that the pension program allows for greater independence and less reliance on eldercare provided by sons.

Aside from the effects of the pension program on the eldercare received by aging parents, we find that the pension also affects the decisions of young parents, including the parental transfer at the time of the child's marriage and the use of sex selection technology prior to childbirth. In particular, the NRPS reduces the brideprice given by sons' parents but does not affect the dowry given by daughters' parents. The NRPS has also led to a less biased sex ratio by increasing the proportion of female newborns. These findings imply that the son-dependent eldercare mode is an important reason for son preference.

Our findings demonstrate the powerful ability of a pension scheme to transform a traditional eldercare mode to a modern approach. The pension program reflects a national cultural change in which the state and formal financial markets would be a greater source of support for old age. By reducing the demand for informal care provided by sons, the NRPS is gradually shifting the norm of support for elderly people and has introduced an opportunity for formal eldercare. With this program, parents will reduce their son preference, leading to a more equal marital transfer between sons and daughters, as well as a less-biased sex ratio. Our findings suggest that social policies can shift the son-preference culture.

CRediT authorship contribution statement

Naijia Guo: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Supervision, Validation, Writing – original draft, Writing – review & editing. **Wei Huang:** Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Resources, Visualization, Writing – review & editing, Validation. **Ruixin Wang:** Data curation, Formal analysis, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing, Investigation, Methodology, Conceptualization.

Appendix A. Online appendix

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.jdeveco.2024.103390.

Data availability

The authors do not have permission to share data.

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[31] Such programs include social pension reforms in South Africa (Krueger and Pischke, 1992; Case and Deaton, 1998; Duflo, 2000; Jensen, 2004), Brazil (de Carvalho Filho, 2008, 2012), and India (Kaushal, 2014).

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