Pension Reform, Child Investment, and Household Savings in China*

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Abstract

Seniors may rely on support from their adult children, which provides an incentive for parents, when young, to invest in their children's human capital. Seniors may also rely on their own savings. Pension policies, therefore, can affect young parents' savings behavior, as well as investment in their children's education. I study the impact of a 1997 pension reform in urban China on household savings and child investment using a difference-in-differences approach. I find that a decrease in pension benefits leads to higher savings and higher investment in children. I estimate adult children's transfers to their parents as a function of their education level, the number of siblings, and parents' pension income. Both adult children's human capital and number of siblings are positively correlated with transfers to senior parents. Transfers from children are substitutes for parents' own savings and pension income.

Keywords: pension reform, human capital accumulation, intergenerational transfers, household savings

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1 Introduction

Intergenerational support from children to senior parents is common in many societies, especially in developing countries where social security systems provide little support and financial markets are underdeveloped.[1] Support from children after retirement provides parents with an incentive to invest in children.[2] Therefore, public pension systems potentially weaken the need for children's support and can undermine parents' incentives to invest in children. Similarly, pensions can weaken the need for private old-age support, private savings. Broadly, public pension transfers affect household decisions on private savings, fertility choices, and human capital investment in children. The literature has discussed the effects of pension reforms on savings and fertility, or savings and human capital investment separately (Cigno (1993), Cigno et al. (2002), Danzer and Zyska (2020), Cremer et al. (2011)). None has studied the effects of pension reforms on household savings, fertility choice, and child human capital investment simultaneously. Studies show that fertility and human capital jointly determine children's support (Oliveira (2016)). Therefore it is important to study the impacts of pension reforms on savings, fertility, and child investment simultaneously.

I study how changes in pension benefits affect household decisions in savings and child investment in the context of China. I exploit the exogenous variation in pension benefit changes of different working units resulting from the 1997 pension reform to examine the causal effects. Using a difference-in-differences (DID) approach, I provide empirical evidence that pension benefit reductions lead to increases in household savings and investment in children's human capital in the working-age population. I further explore the mechanisms of the latter by looking at the substitution effects of pension income on children's transfers to retired parents.

China is an interesting case for studying pension reforms. It launched the first public

[1] Banerjee et al. (2014) show that parents perceive children as an important source of old-age support in China. Jensen and Miller (2017) show that living together is an important way for children to provide old-age support to parents in India.

[2] Becker et al. (2016) show that parents invest more in children's human capital when they expect greater support in old age and tend to manipulate children's preferences to induce them to support them theoretically.

pension reform in 1997 for the urban area and introduced the New Rural Pension System (NRPS) in 2009 for rural residents. However, China still faces challenges in providing social protection to a large aging population with low contribution rates to pensions and large disparities in pension benefits. Understanding the effects of past reforms matters for future policy changes and provides valuable information for other countries.

I use the 1997 pension reform in China as a case study. From the household's perspective, the reform brought about two main changes. First, it expands coverage from public workers and workers in state-owned enterprises (SOEs) to private workers. Second, it reduces pension benefits to maintain financial sustainability. This exogenous change in pension benefits offers a natural experiment to examine the causal effects of pension reform. China has made several pension reforms. However, I focus on the 1997 pension reform in the urban area because the one-child policy restricts the number of children in urban areas at that time. This provides an environment to examine the effects of pension reform on investment in children's human capital without worrying about fertility choices (the quantity-quality trade-off).

I use household-level data from the Chinese Household Income Project (CHIP). It provides information on income, assets, and consumption at the household level, as well as demographic information, such as age, education, and working units at the individual level. One advantage of this dataset is that it provides information on education expenditure on children, which enables me to construct the measure of human capital investment in children.

My identification strategy employs a difference-in-differences approach, exploiting the variation in pension benefit changes for public workers and workers in SOEs. The two outcomes of interest are household savings, measured by financial wealth and the financial-wealth-income ratio, and child investment, measured by education expenditure on the children and children's school enrollment. The treatment group is the SOE workers, whose pension benefit decreases compared to public workers.

The causal effects of pension reform come from comparing the changes of the treatment and control groups after controlling for related variables, such as age, gender, income, and so

on. One challenge is that the composition of the treatment group (SOE workers) changes as a result of massive layoffs in the SOEs following SOE reform during the period of the pension reform. I use information on layoffs and previous working units to include the laid-off SOE workers in the treatment group to mitigate the problem. I further construct measures of income volatility and risk of job loss and use them as controls in my regressions to mitigate the effects of uncertainties.

I find that the reduction in pension benefits following the reform leads to an increase in the household savings rate (measured by the wealth-income ratio) of 42 percentage points. I also find that the enrollment of school-age children increases by 0.4 percentage points and that college enrollment increases by 2 percentage points. Educational expenditures on children increase by 1.5% of their income for the SOE workers. My results are robust to different subsamples, to changes in the measure of outcomes, and to changes in the controls with concerns over the uncertainties in income and employment resulting from SOE reform.

Using data from a panel survey by the China Health and Retirement Longitudinal Study (CHARLS), I examine whether pension income and children's transfers to parents are substitutes by estimating transfers from children to retired parents as a function of children's education and number of siblings and parents' pension income. I find that the probability of pension receivers getting children's transfers is 6.6% less than pension non-receivers. Further, a 1% increase in pension income leads to a 0.05% decrease in transfers from children, which implies that pension transfers and children's support for senior parents are substitutes. Transfers received by the elderly are positively related to the number of children and their education level. This positive relationship gives incentives for young parents to invest in their children.

To summarize, I find that a decrease in pension benefits leads to higher savings rates and higher investment in children for the working-age population. Parents' savings, pension income, and children's transfers are substitutes.

Next, I develop an overlapping generations (OLG) model disciplined by the empirical

findings to illustrate the mechanisms. The model features a pay-as-you-go (PAYGO) pension system, endogenous choices of fertility and human capital investment, and intergenerational transfers from adult children to retired parents. More specifically, I assume that households live for four stages, represented by childhood (c), parent (p), middle age (m), and retirement (r). At the childhood stage, households make no decisions and form their human capital with investments from their parents. At the parent stage, households choose the number of children and investment in them. At the middle-age stage, households transfer part of their income to their retired parents to help support them. At the retirement stage, they receive transfers from their children and live on their savings, pension, and transfers. The key feature is intergenerational linkages: parental choices are important for young children's subsequent income, and adult children's support for retired parents depends on their income. These linkages determine the relationship between pension benefits and child investment. An increase in pension benefits leads to less demand for children's support at the retirement stage. Therefore, young parents have fewer incentives to have children or invest in children. In future work, I will calibrate the model with data from my empirical work and examine the effects on the aggregate economy quantitatively.[3]

1.1 Literature Review

My research is related to two main strands of the literature. First, a large literature studies the impacts of public transfers—especially pensions—on private savings and child investment. Second, a more recent literature studies the effects of pension reforms in China.

My research is closely related to empirical work that studies the displacement effects of pension wealth on private savings. Estimates of the substitution effect vary from very limited (Kotlikoff (1979), Kapteyn et al. (2005)) to large (Gale (1998)). The estimated degree of substitution between public pension and private wealth hinges on the quality of data and empirical strategies. Unobserved traits and measurement errors will affect the estimates of

[3]This calibration will be in the next version of the paper.

the effects (Gale (1998)). Recent work exploits the exogenous pension wealth shifts resulting from pension reforms to mitigate the bias but still finds mixed effects (Attanasio and Rohwedder (2003), Attanasio and Brugiavini (2003), Engelhardt and Kumar (2011), Slavov et al. (2019), Feng et al. (2011), Lachowska and Myck (2018)). Most research finds that public pensions tend to crowd out private savings in both developed and emerging markets, such as the United Kingdom, United States, Italy, Poland, Mexico, and China. Slavov et al. (2019) find few offsets between social security and private savings. Chetty et al. (2014) support the results by showing that most households are "passive savers" who do not respond to retirement policy changes in Denmark. My empirical work complements the existing literature with analysis in the context of China, which is witnessing a rapidly aging population and a series of pension reforms.

My paper is also related to the literature studying the impact of public transfers via social security or pensions on child investment in developing countries.[4] Most research focuses on studying the response of poor households with children living with grandparents. Many studies find that public transfers increase the outcomes of children co-residing with pensioners, such as health or nutrition status (Duflo (2000), Duflo (2003)), infant mortality rates (Li and Mora (2016)), school enrollment (de Carvalho Filho (2012), Ponczek (2011), Gutierrez et al. (2017), Martinez (2004), Bau (2021)), and literacy (Ponczek (2011), Herrmann et al. (2021)), especially for girls.[5] Pensions affect child investment through two channels. Most of the literature argues that pension transfers increase children's human capital through easing liquidity constraints, as poor families cannot borrow to invest in children (Edmonds (2006), Ponczek (2011), de Carvalho Filho (2012), Martinez (2004)). Bau (2021) and Herrmann et al. (2021) argue that old-age support from children resulting from a culture of family ties

[4]Research about the effect of public transfers on child investment includes many developing countries, such as South Africa (Duflo (2000), Duflo (2003), Edmonds (2006)), Brazil (de Carvalho Filho (2012), Ponczek (2011)), Mexico (Gutierrez et al. (2017)), Thailand (Herrmann et al. (2021)), Nepal (Li and Mora (2016)), and Indonesia and Ghana (Bau (2021)).

[5]Girls benefit more because of bargaining power or gender preferences (Ponczek (2011), Duflo (2000), Duflo (2003)). Herrmann et al. (2021) find that older children are more affected by public transfers in the context of Thailand. Li and Mora (2016) find that the effects on the infant mortality rate do not depend on gender.

provides young parents with incentives to invest in their children. Parents' investment in children's human capital during their working age pays off by receiving children's support in their old age.[6] My empirical work contributes to the literature by exploring the channel of old-age support and providing new evidence showing that working-age parents will invest more in children to ensure old-age support when pension benefits decrease. Another contribution of my research is that I study household savings and child investment decisions within a single framework instead of looking at them separately. I examine the trade-offs between private savings and child investment, considering children's support of old age when facing changes in pension benefits.

The paper also contributes to the literature studying the impact of pension reforms in China. Existing studies have examined the influences of the 1997 pension reform on household savings (Feng et al. (2011)), labor supply (He et al. (2019)), and educational investment in children (Mu and Du (2017)). Recently, many research papers examine the impacts of the New Rural Pension Scheme (NRPS), perhaps the largest pension program in the world. Research has studied the effects of the NRPS on the elderly population's health, labor supply (Huang and Zhang (2021), Zhang et al. (2018)), and living arrangements (Cheng et al. (2018)), as well as fertility (Shen et al. (2020)), human capital investment in children (Tang et al. (2021)), migration and employment decisions, and upward transfers (Park and Shan (2020)) of their adult children (Sun et al. (2014)). Park and Shan (2020) study the effects of the NRPS on private transfers and investment in children simultaneously in the rural area and argue that pension access affects child investment through two opposite channels: income effects and substitution effects. In contrast to their work, my paper focuses on the working-age population in the urban area and studies savings and child investment decisions simultaneously. Additionally, my empirical work is able to avoid the endogeneity

[6]Bau (2021) provides evidence that pension expansion decreases practices of kinship traditions to support old parents and investment in the education of children in Indonesia and Ghana. Herrmann et al. (2021) find evidence that is consistent with the channel of children's support by showing that older children benefit more from pension transfers, as they are closer to reaching the labor market and support old parents or grandparents in Thailand. Even though the results are not statistically significant, they do show a supportive pattern.

problem from simultaneous decisions of fertility and human capital investment in children (the quantity-quality trade off) by focusing on the the urban area, as the one-child policy restricts the number of children.

My theoretical analysis is related to papers studying pension reform in an OLG framework (İmrohoroglu et al. (1995), Conesa and Krueger (1999)). The two most closely related papers are Choukhmane et al. (2013) and He et al. (2017). I extend the model framework in Choukhmane et al. (2013) with a pension system and uncertainty regarding income. This extension allows me to analyze the impact of pension reform in consideration of income shocks. As mentioned in the empirical section, SOE reforms occurred simultaneously with pension reforms at the end of the 1990s, which led to increases in income uncertainty. Adding the feature of income uncertainty allows the model to discuss the impacts of these two reforms. He et al. (2017) examines the effects of a decrease in pension benefits on labor supply and savings in an OLG framework. My paper studies fertility and child investment along with savings. Therefore, I introduce endogenous fertility and human capital investment in my model but abstract from labor supply. My paper is also closely related to the literature discussing fertility and social security (Barro and Becker (1989), Boldrin and Jones (2002), Boldrin et al. (2015)). I follow Boldrin and Jones (2002) and introduce endogenous fertility by assuming an "old age security" motive for fertility or child investment. My paper is also related to papers studying pension systems with human capital formation (Cremer et al. (2011), Vogel et al. (2013), Poutvaara (2007), Lau and Poutvaara (2006)). My paper contributes to the literature by discussing endogenous fertility and human capital investment simultaneously with an old age security motive.

The paper is organized as follows. Section 2 describes the 1997 pension reform. Section 3 introduces the data and empirical strategy. Section 4 discusses the empirical results and robustness checks. Section 5 describes the model and Section 6 briefly illustrate the plan of calibration. Section 7 concludes.

2 Institutions Background: 1997 Pension Reform

China's current public pension system is a result of a decades-long evolution. The most important reform happened in 1997 and built the modernized three-pillar pension system in the urban area of China.

The first formal public pension system was established in 1957 and covered only employees in the SOEs and public sector.[7] The replacement ratios of pension benefits were the same for workers in the SOEs and public sector—70% to 90%—which means retired workers can receive 70% to 90% of their pre-retirement income. But the financing mechanisms of pensions of public workers and SOE workers were different. Pensions of public workers was funded by fiscal spending, whereas pensions of workers in SOEs were funded by enterprises. In addition, enterprises provided housing, medicare, and social security to their workers. In the 1980s, the pension system of SOE workers based on enterprises became unsustainable and led to a large financial burden on older enterprises. Moreover, the private sector grew quickly during the move toward a market economy. The enterprise-based pension system restricted labor mobility, and private workers did not have pension insurance. The late 1980s and early 1990s saw a series of pension reforms to enlarge the pooling base from enterprises to provinces and expand coverage to private workers. The State Council started encouraging pension fund pooling at the municipal level on a pay-as-you-go (PAYGO) basis in the late 1980s and then enacted reforms to pool the pension system at the province level. Several pilot programs extended coverage from workers in SOEs to workers in other enterprises in the early 1990s. However, the generous retirement benefits remained unchanged in most provinces until 1997. The 1997 pension reform introduced a multi-pillar system with a declining replacement ratio to urban workers in the whole country. Its goal is to build a pension system that covers all types of urban employees, including workers in the SOEs and private sector.

The basic framework of the new pension system was established in 1997, as shown in

[7] "Public employees" refers to the workers in the public sector and institutions that are mainly financed by fiscal spending, such as institutions related to education, research, and health.

Table 1. It has three pillars: a pooling account, a compulsory individual account, and a supplementary employer-sponsored annuity account voluntarily provided by employers via commercial insurance. The first pillar imposes a 17% payroll tax (paid by employers), which ensures a 35% replacement ratio for an employee working more than 15 years with an average income. The second pillar requires a contribution rate of 11%, of which 8% is from employees. After retirement, qualified employees receive a monthly benefit from the individual account calculated by the accumulated contributions divided by 120. The rate of return in the individual account is determined by the local government and tied to the deposit interest rate. The target replacement ratio of the first two pillars is 59%.[8] Mandatory retirement age is 60 for males, 55 for females, and 50 for blue-collar females.

The 1997 pension reform not only expanded coverage but also reduced the replacement ratio, particularly for young workers in the SOEs. Table 1 summarizes the pension benefit arrangements before and after the reform. The detailed pension benefit calculation formula is in the Appendix A.1. As mentioned above, the target replacement ratio, 59% for an average-wage worker, is lower than that before the reform, 70% or more. According to the new pension framework, workers who retired before 1997 ("old workers") remained in the original pension system, which means their pension benefits stay the same. Workers who entered the labor market in or after 1997 ("new workers") joined the new pension system, which means their replacement ratio is lower than the so-called old workers. Workers, who started working before 1997 and retired or will retire after 1997 ("middle workers"), joined a transitional pension plan, which means their pension benefits are between the old workers and new workers.

To conclude, the pension reform brought about two main changes for urban workers: an expansion in pension coverage and a decrease in pension benefits. Decreases in pension benefits vary among workers of different ages and within different sectors. After the pension

[8]The replacement ratio is published by the Ministry of Human Resources and Social Security (MOHRSS) of China. It is based on the assumptions that life expectancy is 70 and the growth rate of real wages is equal to the real interest rate. An average-wage worker who contributed to the system for 35 years would have a combined replacement rate of 59%—24% from the individual account.

reform, the pension benefits of public workers remain the same.[9] SOE workers join the new pension system. Middle workers and new workers who suffered a decrease in pension benefits are mainly the employees in the SOEs. The transitional pension benefits were to compensate the decreases in pension benefits for middle workers. They did not have an individual account before the reform and hence had no accumulated wealth there for their working years before the reform. The arrangements of transitional pension benefits are to compensate for the empty individual accounts. Therefore, the pension reform leads to a higher decrease in the pension benefits of younger workers who just started working before 1997 relative to the ones on the verge of retirement after 1997. For the new workers entering labor market in 1997, the reform has no effect on their pension entitlements.

Table 1: Pension arrangements before and after the 1997 reform

	Pre-reform	Post-reform		
		New workers	Middle workers	Old workers
Benefits	Basic benefit	Basic benefit + individual account	Basic benefit + individual account + transitional benefit	Same as in pre-reform
Replacement ratio	70-90%	59% [10]	59% - 90%	70%-90%
Contributions	No contributions from employees	28% of total wage (8% from employees) 11% into the individual account	Same as new workers	Same as pre-reform
Retirement age	60 for male, 55 for female, 50 for female blue-collar workers	Same as pre-reform		

[9]Public workers stay in the public employee pension system funded by fiscal expenditures, and that pension system does not change.

3 Data and Empirical Strategy

To empirically study the effects of pension reform on household savings and child investment, I exploit the variation in changes of pension benefits across different types of workers induced by the pension reform and use a difference-in-differences (DID) approach as the identification strategy.

3.1 Data

I use household information from the Chinese Household Income Project (CHIP) for my empirical analysis. The CHIP consists of repeated cross-sectional data from a household survey conducted by the China Institute for Income Distribution and National Bureau and Statistics (NBS).

The CHIP conducted five waves of surveys nationally from 1988 to 2018, covering rural and urban areas separately. Apart from information on demographics, income, and expenditures, the survey also contains topics related to household characteristics such as number of children and their educational achievements. As the 1997 pension reform targeted urban workers, I use data on urban households from the 1995 and 2002 waves, which bracket the pension reform.

The CHIP surveys 6,868 urban households in 1995 and 6,835 urban households in 2002. I restrict the sample to working-age (ages 23–59) households. Further, I focus on labor force participants and exclude households whose head is retired but include households whose head is currently unemployed or laid off. I mainly focus on workers in the public sector and SOEs, who enjoyed similar pension benefits before the reform. I drop observations with children older than the household head or when the difference in their ages is less than 10. I also exclude observations with potential outliers in terms of wealth and income.[11]

[11]The outliers are identified by the distance from the observations to the quartiles. Here, I first calculate the inter-quartile range (IQR), which is the distance between the values of the 25th percentile ($Q1$) and the 75th percentile ($Q3$), denoted by $IQR = Q3 - Q1$. Then, I only keep the observations within the range $(Q1 - 3IQR, Q3 + 3IQR)$.

One outcome of interest is household savings. I construct two measures of savings: the level and rate of savings. To measure the level of household savings, I use total household assets constructed as the sum of self-reported values of financial assets, housing assets, durable goods, and so on.[12] The main result uses financial wealth as the measure of household savings. I also construct other measures of household savings by excluding long-term investment or by including housing assets to conduct a robustness check.[13] Using the stock of financial wealth as the measure of savings instead of the flow of savings, which is measured as the residual between household income and consumption, has two benefits. First, financial wealth captures the average or long-run savings behavior better than the flow of savings by avoiding the influence of high-frequency fluctuations in income or expenditures. Second, financial wealth measures cumulative savings directly and is less subject to measurement errors than the flow of savings calculated indirectly using information on household income and consumption.

The second measure is the savings rate defined as the wealth-income ratio following He et al. (2018). "Wealth" means total financial assets, defined as above. "Income" means permanent income, constructed using the history of individual income following Fuchs-Schündeln and Schündeln (2005). Although CHIP is a cross-sectional survey, it includes retrospective questions on income in the recent past for household heads. More specifically, the 1995 survey reports earnings in the period 1990 through 1995, and the 2002 survey reports earnings in 1998 through 2002. Using the history of individual income, I construct the permanent income measure by taking the average of individual income and adjusting it to the household level. [14]

The other outcome of interest is human capital investment in children. I construct two measures of child investment: capital investment and school attendance of the children.

[12]CHIP surveys include detailed questions related to household wealth, including financial assets (such as checking or savings accounts, investments in bonds, stocks or enterprises, and so on), housing wealth, and durable goods.

[13]Appendix B.1.1 shows the details of constructing the measures. Section 4.4.1 discusses the results using different measures.

[14]Appendix B.1.1 shows the details of constructing the permanent income measure.

The first measure is the total educational expenditure on children, constructed using self-reported household educational expenditure, including school fees, extracurricular activity costs, child-care costs, and so on.[15] The second is the school enrollment rate of the children at school age. CHIP surveys the current status of schooling and the educational level of all household members. I construct the enrollment rate of school-age children at the household level according to those questions. I define two enrollment rates based on the age of children: school-age enrollment and college-age enrollment. School age is defined as ages 6 to 18, which covers the usual elementary to high school years in the Chinese education system, and college age is ages 19 to 23.

Table 2 shows summary statistics by year and working sector of the household head.[16] It shows that some controls, such as the average age, gender, marital status, and number of children, are similar between public workers and SOE workers and did not change much over time. Some of the controls, however, had large changes over time. During the period, the Chinese economy experiences rapid growth. Therefore, household income, consumption, and assets increase rapidly. Some changes are induced by specific policies. For example, changes in home ownership, health insurance, and employment in the SOEs can be traced to privatized policies in the late 1990s (Chen et al. (2020), He et al. (2018), Hu et al. (2011)). The changes in home ownership and health insurance type between 1995 and 2002 are similar for workers in the public sector and SOEs. Both increase home ownership by over 35 percentage points, and more than 30% of them switch from public health care to public health care insurance on average.[17] I control for variables related to those policy initiatives

[15]Educational expenditure in the CHIP survey is at the household level, which means it is the total expenditure on all children. Given that I cannot separate the educational expenditure on each child, it is necessary to control for the number of children at school as well as their ages. Another way to examine the effects is to construct the average expenditure on each school child as the dependent variable and control for their average age.

[16]Appendix B.1.1 provides definitions and detailed information for each variable.

[17]A reform in 1998 focuses on the health care system's attempts to establish a basic health insurance system for urban staff and workers. Before the reform, SOE workers are in the Labour Insurance System (LIS), and public workers are in the Public Health Insurance System (PIS). The reform consolidates the PIS and LIS into one insurance program and extends coverage to all urban employees except for the self-employed (Hu et al. (2011)). Both public workers and SOE workers are affected by the reform except the ones working for the central government and some institutions.

and run several robustness checks to show that those policies do not drive my main results. Employment change in the SOEs is a big concern for my empirical research, given that I mainly focus on the public sector and SOEs. However, the CHIP surveys the experience of laid-off workers in the years after the SOE reform. I back up the previous SOE workers using the information on layoffs and include this information in the SOE sector.[18]

3.2 Identification Strategy

I investigate the short-run effect of the pension reform on household savings and child investment using the DID method. The exogenous change in pension generosity and availability brought about by the 1997 pension reform allows for the estimation of causal household responses by comparing savings and child investment trends between the treatment and control groups before and after the reform. I mainly exploit the variation in pension benefit changes between workers in the public sector and SOEs.[19]They were both covered in the old pension system and enjoyed similar arrangements of pension benefits before the reform. Workers in the SOEs suffered from a decrease in pension benefits after the 1997 pension reform. This research design is not sensitive to the time-invariant differences between the treatment (SOE workers) and control groups (public workers), such as patience, a risk-averse attitude, or altruism toward child. It also accounts for the macro trends or national reforms that affect the two types of workers similarly. [20]

Formally expressed, my reduced-form model with repeated cross sections can be written

[18]Appendix B.1.2 provides details of the SOE reform and a definition of the SOE sector.

[20]I do not exploit the variation in pension availability between the workers in the public sector and workers in the private sector in this design. The main reason is that I have a few observations on private workers before the pension reform in my data. Private workers did not account for a big fraction of the total number of urban employees in the early 1990s. Most enterprises are owned by the governments until the SOEs reform.

[20]During the 1990s, China launched several reforms in the economic and social security system, such as the SOE reform, health care reform, housing market reform, pension reform, and so on. Most of the reforms affect public workers and SOE workers similarly, except for the SOE reform and pension reform.

as follows:

$$y_{isrt} = \alpha + \beta(SOE_s \times POST_t) + \gamma SOE_s + \lambda_t + \phi_r + \psi' X_{isrt} + \varepsilon_{isrt} \quad (1)$$

The dependent variable y_{isrt} represents the measures of savings or child investment of household i working for sector s in region r in year t; SOE_s is an indicator variable for workers in the SOEs; and $POST_t$ is a dummy variable that indicates the observations in the years after the pension reform in 1997. The interaction of interest, $SOE_s \times POST_t$, indicates that SOE workers' pension benefit decreases after the pension reform. Its coefficient β captures the differential trends in the outcome variables between the treatment and control groups. The model includes a year fixed effect, λ_t, to capture macro economic changes in different years. I also add region fixed effects, ϕ_r, to capture the time-invariant regional factors. Finally, the model setup also contains time-varying covariates X_{isrt}. The set of controls includes demographic characteristics of the household head, such as age, age squared, a dummy for married, a dummy for female, and dummies for health care insurance. Job-related characteristics are dummies for occupation, dummies for workers' laid-off experience, and income variance as a risk measure. Household-related characteristics are the number of children, average age of children, and a dummy for home ownership.

The key assumption of this model setup is that no omitted confounding factors affect the outcomes of the treatment and control groups differently before and after the pension reform. So the difference in trends between the treatment and control groups is only caused by the pension reform. One concern is the SOE reform, which caused massive layoffs of SOE employees in the late 1990s. This event changed the composition of the treatment group, which in my data contains only the survivors of the SOE reform after the pension reform. To solve this, I define SOE workers by their previous employers if they had experienced a layoff.[21] The CHIP survey collected information on layoffs and employer information if

[21]SOE workers and public workers are permanent workers or those with long-term contracts. I exclude temporary or short-term contract workers in the definition because they are not covered by the pension system.

workers changed jobs. I exploit this information to revise the definition of the SOE sector and public sector.[22] Table 3 compares the fraction of public workers and SOE workers in the total observation. It shows that the number of SOE workers increases by 14% and the number of public workers increases by 1% in 2002 under the new definition. Compared to the pre-reform period, the number of SOE workers is still 14% less. When I use a broader definition of the SOE sector which assumes that all the workers who experienced a layoff are in the SOE sector, the difference in the fraction of SOE workers between the pre-reform period and post-reform period is very small.

My identification assumption is that SOE workers and public workers would have had similar trends in their savings rates or child investment if the 1997 pension reform had not occurred. However, I am not able to test the parallel trend assumption of the outcomes directly using CHIP because of the lack of household data in the pre-trend period. To mitigate concerns about this assumption, I examine the pre-trends in related outcome variables of the treatment and control groups using data from other surveys.

First, I collect information on income and consumption from China Health and Nutrition Survey (CHNS), which is a panel survey conducted by the University of North Carolina at Chapel Hill and the Chinese Center for Disease Control and Prevention (CCDC). The survey covers the years 1989 to 2015 and contains questions related to income and consumption. It includes detailed information on income, such labor earnings, agricultural income, business income, and capital income. For consumption, however, the survey only contains some categories of non-durable consumption. The major non-durable consumption item documented in CHNS is food consumption in the Nutrition Survey. The other items of consumption include utilities, child care, health services, and housing services. I construct the consumption

[22]CHIP collected information related to workers' experience of being laid off and changing jobs. The specific survey questions for currently working households are: Have you experienced being laid off before? How long did it last? Have you changed jobs in the most recent three years? What is the ownership of your previous job? Why did you leave the previous job? Has your employer changed ownership? When? For the workers who remain laid off, the survey asks: What was the ownership of your employer when you first got laid off? Were you in a long-term contract then? I use all of those questions to pin down their working sectors, and the details are explained in Appendix B.1.2

measure by adding the consumption of food, utilities, and health services. To examine the validity of assumption of parallel trend, I estimate the event study coefficients β_t of each year using Equation (2):

$$y_{it} = \alpha + \sum \beta_t I_{TREAT_{it}=t} + \beta_2 TREAT + \beta_3 AFTER + \lambda_t + \phi_i + \varepsilon_{it}, \tag{2}$$

where y_{it} is the outcome variables of household i at year t, $I_{Treat_{it}=t}$ is the dummy of treatment group at year t, $TREAT$ is the treatment dummy, and $AFTER$ is the dummy of years after the pension reform.[23] The omitted year is 1993.

Figure 1 shows the parameters of interest β_t. The outcome variables are household income and consumption. β_t of years before the pension reform are not significantly different from zero, which supports the assumption of parallel trend.

Second, I use expenditure on child care from CHNS to examine the parallel trend of human capital investment.[24] Figure 2 shows that the parameters of interest β_t are not significantly different from zero. The result supports the assumption of parallel trend.

4 Results and Discussion

This section reports the main findings obtained by estimating Equation (1). I find that a decrease in pension benefits leads to an increase in household savings and child investment.

[23]One caveat is that the definition of the public sector is different from the one in CHIP. The public sector in CHNS includes all levels of government and public institutions, as well as firms owned by the central government, whereas in the CHIP dataset, the public sector only includes government and public institutions. Firms owned by the central government are included in the SOE sector. Correspondingly, the SOE sector only includes the small or large collective enterprises owned by local governments in CHNS. However, the parallel trends here can reflect the trends in the two groups in CHIP since the two definitions just differ in the degree of treatment between the two groups, which means the difference is smaller in CHNS.

[24]The survey includes education expenditures but only for the year 2005. Therefore, I mainly use this dataset to examine the pre-trends instead of running my experiments for the pension reform. Appendix **??** shows details of the data information.

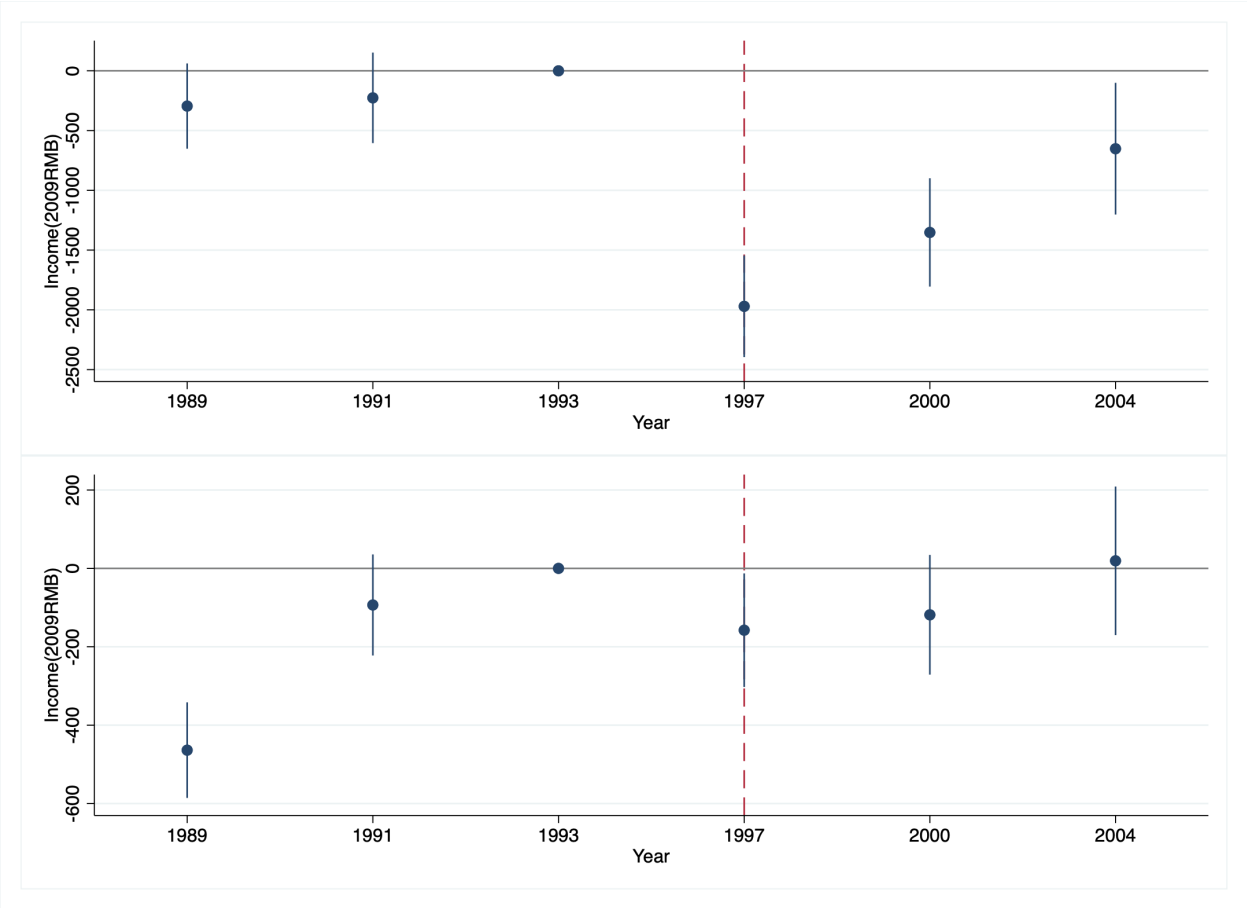

Figure 1: Parallel Trend in Income and Consumption

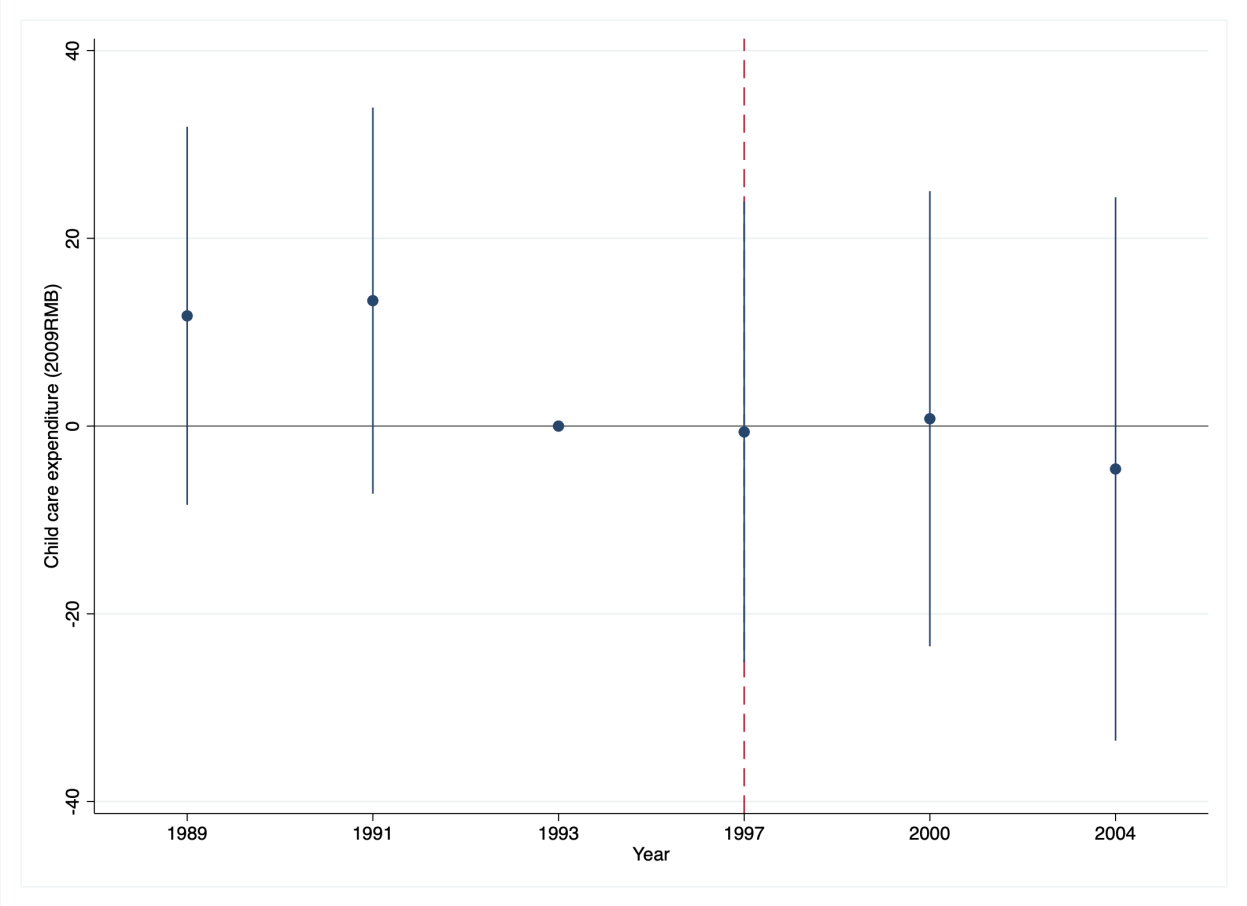

Figure 2: Parallel Trend in Expenditure on Child Care

4.1 Household Savings

In this section, I examine the impact of the 1997 pension reform on household savings. I employ a DID approach to estimate the intention-to-treat effect using Equation (1). The outcome variable, y_{isrt}, represents the savings level measured as total financial assets or savings rates measured as the wealth-income ratio of household i working for sector s in region r and year t. I control for household demographics and characteristics that may affect household savings, including age of household head, gender, education, occupation, health insurance type, marital status, household size, child age, number of children at school, household income, and so on. I also control for the layoff experience and income risk to control for the effects of the SOE reform. Following Fuchs-Schündeln and Schündeln (2005), household permanent income is instrumented by education, age, age squared, and their interactions to mitigate potential measurement errors. In the data, the household financial wealth measure is left-censored at zero; therefore, I estimate Tobit models left-censored at zero.

Table 4 presents the results. In columns (1)-(2), I examine the levels of household savings, and in columns (3)-(4), I examine savings rates. The dependent variables are total financial wealth and the wealth-income ratio, respectively. In odd-numbered columns (1) and (3), I use the revised definition of the SOE sector by adding the workers who were laid off from SOEs or changed jobs from SOEs. In even-numbered columns (2) and (4), I use the broader definition of the SOE sector by assuming all the workers with layoff experience are from SOEs.

Focusing on the results in the odd-numbered columns, I find that the 1997 pension reform increases the savings of SOE workers by around 4800 RMB, which is 48% of the control group baseline level, and increases the saving rates by 42.6 percentage points, which is 31% of the control group baseline level. The results are similar when I use a broader definition of SOE workers. These results show that a reduction in pension benefits increases household savings.

4.2 Child Investment

Transfers from adult children are another form of insurance during old age. Therefore, changes in pension benefits affect two decisions of working-age households simultaneously: savings and child investment. In this section, I examine the impact of the 1997 pension reform on child investment using a DID approach by estimating Equation 1 with CHIP data. To study the impacts on child investment, I exclude households without children to avoid the large extensive margin effect. Further, I restrict the sample to households with at least one child in school. I also exclude households with extreme educational expenditure-income ratios.[25]

The outcome variable represents educational expenditure or school enrollment rate. For the educational expenditure, similar to savings, I use both levels and the expenditure-income ratio as the dependent variable. I use the household total educational expenditure on children to measure the monetary investment in the children. Because CHIP only reports the total household expenditure on children's education, I am not able to distinguish expenditures on each child. I restrict the sample to households with only one child to control for the quantity-quality trade-off effect. Under the one-child policy, the average number of children in a household is about one. By restricting the number of children to one, I can mitigate the selection of wealthy households who can afford the fine for having more children. In that case, the total educational expenditure also represents the investment on the only child. I also present the result with all households with a positive number of children but controlling for the number of children and their average age as a robustness check. Other controls are the same as the ones in the estimation of household savings, including household head's demographics and household characteristics. The other measure of monetary investment is the expenditure-income ratio, which represents the ratio of total household educational expenditure in permanent income.

[25] I identify the extreme values by the distance from the observations to the quartiles. If the distance is more than three times the interquartile range to the first or third quartile, I treat it as an extreme value or outlier.

For the school enrollment rate, I use two measures: school-age enrollment and college enrollment. I define school age as between ages 6 and 18, which covers the usual elementary through high school years, and college age as between ages 18 and 23. According to children's age, I separate them into two groups. The outcome variable is a dummy indicating that the child is (or is not) a full-time student. As in the study of child investment, I restrict the sample to households with one child only.

Table 5 shows the results of educational expenditure. Columns (1)-(2) and (5)-(6) use the revised new definition of SOE workers, and the rest use the broader definition of SOE workers. Even-numbered columns show the results using the sample of households with only one child, and odd-numbered columns use all the households with a positive number of children. Focusing on the results in the even-numbered columns, I find that pension reform increases SOE workers' expenditure on children's education, although the amount of the expenditure is not significant. On average, pension reform leads to SOE workers increasing their educational expenditure on children by about 1.5% more of their income relative to public workers. This finding shows that a decline in pension benefits leads to households spending more on their children's education.

Next I examine the impact of the 1997 pension reform on school enrollment. Table 6 shows the results of the school enrollment of children. I separate the children into two groups according to their age. Columns (1) and (2) are for school-age children, columns (3) and (4) for college-age children. I find that the 1997 pension reform increases the children's enrollment rate for both groups although not significantly. Focusing on the odd-numbered columns, the 1997 pension reform increases school-age enrollment by 0.4 percentage points, which is90% of the baseline enrollment rate in the control group. The college enrollment rate increases by more than 2 percentage points as a result of the reform, which is 32% of the control group baseline level.

4.3 Mechanisms

In this section, I examine whether pension income and children's transfers are substitutes. The change in pension benefits affects parental investment in children because pension income and transfers from children after retirement are substitutes. In other words, there is a negative relationship between pension income and children's transfers to retired parents. When pension benefits decrease, working-age households can ensure old-age consumption through increasing private savings or investment in children. In this section, I test this assumption by examining the crowding-out effect of pension benefits and children's transfers. I also study the relationship between children's transfers and the number of children or the level of children's education. If they are positively correlated, this provides an incentive to invest in fertility or the child human capital of working parents to ensure their retirement life.

In this section, I use data from CHARLS, which is a longitudinal study of individuals over age 45 in China. So far, it has conducted four waves: 2011, 2013, 2015, and 2018. [26] The survey includes detailed information about inter vivos transfers between parents and children, labor supply and income, wealth, health status, personal caring, pensions, and so on. I focus on the urban population and use the paired couple information as households.

4.3.1 Pension Benefit Changes Across Cohorts

I first examine the ex post pension coverage and pension income change across cohorts after the reform. Households born in different years face different changes in pension benefits and coverage. According to the details of the 1997 pension reform, the pension benefits of households retiring before 1997 (old workers) do not change. For households that started working before 1997 and retired after 1997 (middle workers), their pension benefits decrease compared to the old system, but with some degree of compensation through transitional

[26] Note that the survey is conducted during the second half of the year. Some of the interviews are done in the first three months of the following year. To simplify, I use the starting year as the time.

pensions. Households that started working after 1997 (new workers) join the new pension system and suffer from the largest decrease in pension benefits. Based on the regulation, I define three cohorts: 1940 cohorts (born before 1946), 1950 cohorts (born between 1946 and 1955), and 1960 cohorts (born between 1956 and 1965). The 1940 cohorts mostly retired before 1997 and, as old workers, were not affected by the 1997 pension reform. The 1950 cohorts are the middle workers. The 1960 cohorts are the relatively new workers whose pension benefit decreases the most. I compare the pension coverage and pension income change of the three cohorts by running the following regression:

$$y_{it} = \alpha + \beta Cohort_i + \lambda_t + \psi' X_{it} + u_{it} \tag{3}$$

where y_{it} represents the outcome variable of household i at year t. The term $Cohort_i$ is the dummy of cohorts; X_{it} are the controls for age, age squared, education level, and number of children; and β captures the cohort differences. The 1940 cohort is the baseline.

To examine changes in pension coverage, I use a dummy for receiving any pension income as the outcome variable.[27]I further restrict the sample to retired households to study the change in pension coverage. For changes in pension benefits, I use log pension income as the outcome variable. Further, I only focus on the individuals who receive any pension income to study the changes in pension benefits.

Table 7 presents the pension coverage and pension income of different cohorts. Column (1) shows that pension coverage increases by 20% in the 1950 cohort and by 24% in the 1960 cohort compared to the 1940 cohort. For pension income, the pension benefits of the 1950 cohort increase slightly by 0.1% and are not significant if I focus on column (3). The pension benefits of the 1960 cohort decrease significantly by 1%. Additionally, there is a significant negative relationship between pension income and number of children. Although

[27]Pension income here is defined as private pension income in CHARLS. It includes pension benefits from either government or a work unit. That belongs to the public pension system except for the supplemental pension insurance from enterprises via commercial insurance. That accounts for a small fraction of the whole pension system. So I ignore this part here and assume that pension income is all from the public pension system.

this is not a causal correlation between fertility and pension, the negative correlation reflect the trade-off in households' choice about fertility and pension savings.

4.3.2 Children Transfers and Pension Income

Next, I examine the relationship between upward transfers from children to parents and pension income. I use the inter vivos transfers data from CHARLS to examine their relationship. CHARLS reports transfers that households received from children, as well as transfers from households to their parents. Therefore, I examine children's transfers from two aspects: the view of the retired parents and the view of children supporting their parents. First, I examine whether transfers received for retired parents are negatively correlated with their pension income. Second, I study the relationship between children's transfers to their retired parents and their education level, which provides incentives for parents' investment.

I first examine the relationship between elderly pension income and children's transfers using Equation 4. I use two outcome variables: a dummy for receiving any transfers from children and the log of the amount of transfers. Correspondingly, I use two measures of pension income. One is a dummy variable that indicates receiving or not receiving any pension income. The other is the log of pension income. I restrict the sample to retired households to study this relationship:

$$y_{it} = \alpha + \beta PensionIncome_{it} + \phi_i + \lambda_t + \psi' X_{it} + u_{it} \tag{4}$$

where y_{it} represents the outcome variable of household i at year t; $PensionIncome_{it}$ is the measure of pension income; and X_{it} are the controls for age, age squared, number of children, and log labor income. I also control for whether or not the parents co-reside. The coefficient? variable? β captures the relationship between pension income and children's transfers.

Table 8 shows the estimation results of the relationship between transfers and pension income. It shows that pension income is negatively correlated with children's transfers. On the extensive margin, receiving pension income decreases the probability of receiving

children's transfers by 6.6%. On the intensive margin, a 1% increase in pension income leads to a 0.05% decrease in children's transfers. The result also shows that the number of children is positively correlated with children's transfers, which is consistent with the finding in Oliveira (2016). This finding implies that one way to ensure old-age life is through an investment in the number of children.

I then examine upward transfers from children to parents from the view of children. I study the relationship between children's demographic characteristics and their transfer decision using Equation 5. Similar to the approach used before, I use two measures of sending transfers to parents: a dummy for sending transfers and the log of the amount of transfers. I control for age, age squared, earned income, number of living parents or spouse's parents, and mother's age. The correlation I am interested in is the relationship between transfers and number of siblings or their education, which reflects the quantity-quality trade-off in terms of old-age support:

$$y_{it} = \alpha + \beta_1 Educ_{it} + \beta_2 NumberofChildren_{it} + \psi' X_{it} + u_{it} \tag{5}$$

where y_{it} represents a dummy for sending money to parents or the log of the amount of transfers of individual i at year t; $Educ_{it}$ is the education level; andX_{it} represents the controls.

Table 9 displays the estimation results of the relationship between transfers to parents and education, or number of siblings. Columns (1) and (2) reveal that children with a higher education level or higher income have a greater probability of sending money to their parents. The number of siblings is positively correlated with the probability of a child sending transfers, which may indicate some level of peer pressure and gives working parents more incentive to invest in their children to support their old-age life. I also examine the relationship between transfer levels and children's characteristics using the log of the amount of transfers as the dependent variable. I exclude households that do not send any transfers to study their relationship. Columns (3) and (4) indicate that education and number of siblings

are positively correlated with children's transfers, whereas there is no significant relationship between the income and transfers level, which means that children with higher income tend to make transfers, but the amount is not affected by their income.

4.4 Robustness

In this section, I examine the sensitivity of my estimation results by changing strategies, measures of outcome variables, and samples.

4.4.1 Alternative Measures of Wealth

In this section, I examine the sensitivity of household savings using alternative samples or measures. First, I exclude households with zero wealth. The empirical results reported above are obtained with the sample that includes households with zero wealth. Households' level of borrowing and saving is restricted as the financial market is not well developed. More than 10% of the households hold zero wealth. Therefore, I exclude the households with zero wealth to reexamine my estimation results. Second, I use alternative measures of wealth to examine the sensitivity of my results. The measures include very liquid assets (VLA) and non-housing non-business wealth (NHNBW), which are common measures in other related literature (Carroll and Samwick (1998), He et al. (2018)). I also use total assets including housing values to measure savings as many households use housing as a way of saving, given the less-developed financial markets in China at that time?.[28]Third, I use different age groups to examine the effects. Gourinchas and Parker (2002) shows that young households save mainly for precautionary reasons, whereas old households mainly save for retirement. I separate the households into young (ages 25-39) and old (ages 40-50) groups according to their age to examine the effects.

Table 10 reports the results of the robustness checks. Panel 2 shows the results of eliminating zero-wealth households. The sample size reduces to 6,910 observations, and the

[28]Appendix B.1.1 provides specific definitions of the alternative wealth measures.

magnitude of the estimated effects on savings or saving rates decreases modestly. Panels 3 to 5 show the estimation results using alternative wealth measures. The effects are similar when I change the measures of wealth except for the one with housing. As housing values in CHIP are estimated according to their market value, they suffer from large measurement errors. Overall, the table shows that my estimation results are not sensitive to the measures of wealth. Panels 6 and 7 show the results with different age groups. Young households (ages 25-39) increase their level of savings more, but their savings rates increase less. Young households face a greater pension benefit decrease relative to older households. Their estimation results for savings levels and savings rates both increase significantly, whereas old households (ages 40-54) increase their savings rates more. This is consistent with the finding in Gourinchas and Parker (2002) that young households behave like buffer-stock agents and old households behave more like certainty-equivalent agents.

4.4.2 Cohort Variance

In this section, I exploit the cohort variation in the change in pension benefits to study the impact of pension reform.

After the pension reform, changes in pension benefits vary according to households' working and retirement time. Old workers, who retired before 1997, remain in the old pension system, which means their pension benefits stay the same. New workers, who enter the labor market after 1997, join the new pension system. Their pension benefits decrease compared to the workers in the old pension system. Middle workers, who entered the labor market before 1997 and retire after 1997, join a transitional pension plan. Their pension benefits are between the old and new workers. I define four cohorts according to the birth year: before 1947, between 1948 and 1957, between 1958 and 1967, and after 1968. Most of the oldest cohorts are old workers, whose pension benefits do not change. Most of the youngest cohorts are new workers, whose pension benefits decrease the most.

To examine the pension reform effects, I estimate Equation (6) for SOE workers and

public workers separately. Then I plot the margins of cohorts before and after the pension reform. Changes in the margins of cohorts reflect the effects of the pension reform. I show the margins of SOE workers and public workers separately. The results on public groups serve as a robustness check. There should be no effects on the outcome variables of the control group (public workers), as their pension benefits do not change:

$$y_{ict} = \alpha + \beta(COHORT_c \times POST_t \times AGE_a) + \psi' X_{ict} + u_{ict}, \tag{6}$$

where y_{ict} represents savings rates measured by the wealth-income ratio and the education expenditure on children (% of household income); $COHORT_c$ is a dummy for cohorts; $POST_t$ is a dummy indicating after the reform (or not); AGE_a is a dummy for each age; and X_{ict} represents income, age of children, and number of children.

Figure 3 shows the results of savings rates. As shown, public workers experience no significant change in savings rates. The savings rates of SOE workers increase significantly for the older cohorts born before 1968, whereas the pension benefits of public workers do not change. Therefore, public workers should not experience any effects. The pension benefits of SOE workers decrease, and they increase their savings rates correspondingly. The results are consistent with the pension reform effects estimated using the previous strategy. Additionally, the savings rates of young workers do not increase significantly, whereas the savings rates at old age increase the most. This is consistent with the literature finding that younger households save out of a precautionary motive and older households save out of a life-cycle motive (Gourinchas and Parker (2002)). Focusing on the middle age, we see that younger cohorts (born between 1958 and 1967) increase their savings rates more than the older cohorts (born between 1948 and 1957) at the same age. Younger cohorts have a larger decrease in pension benefits. Therefore, they increase their savings more than the older cohorts. This result is consistent with our previous findings.

Figure 4 compares the education expenditure (% of income) by cohorts before and after the pension reform. Similar to the results from the savings rate, the education expenditure

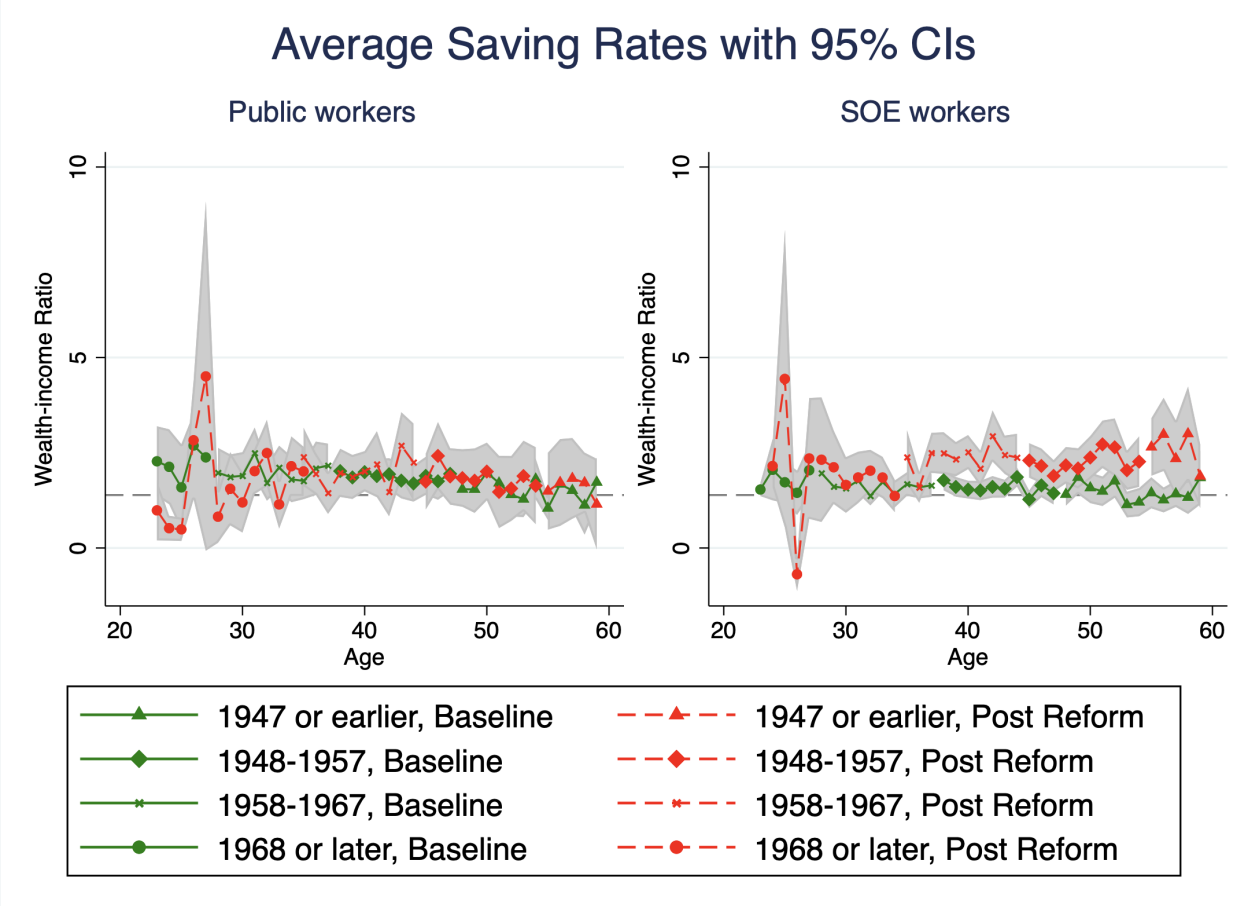

Figure 3: Average Savings Rates (Wealth-Income Ratio) with 95% CIs

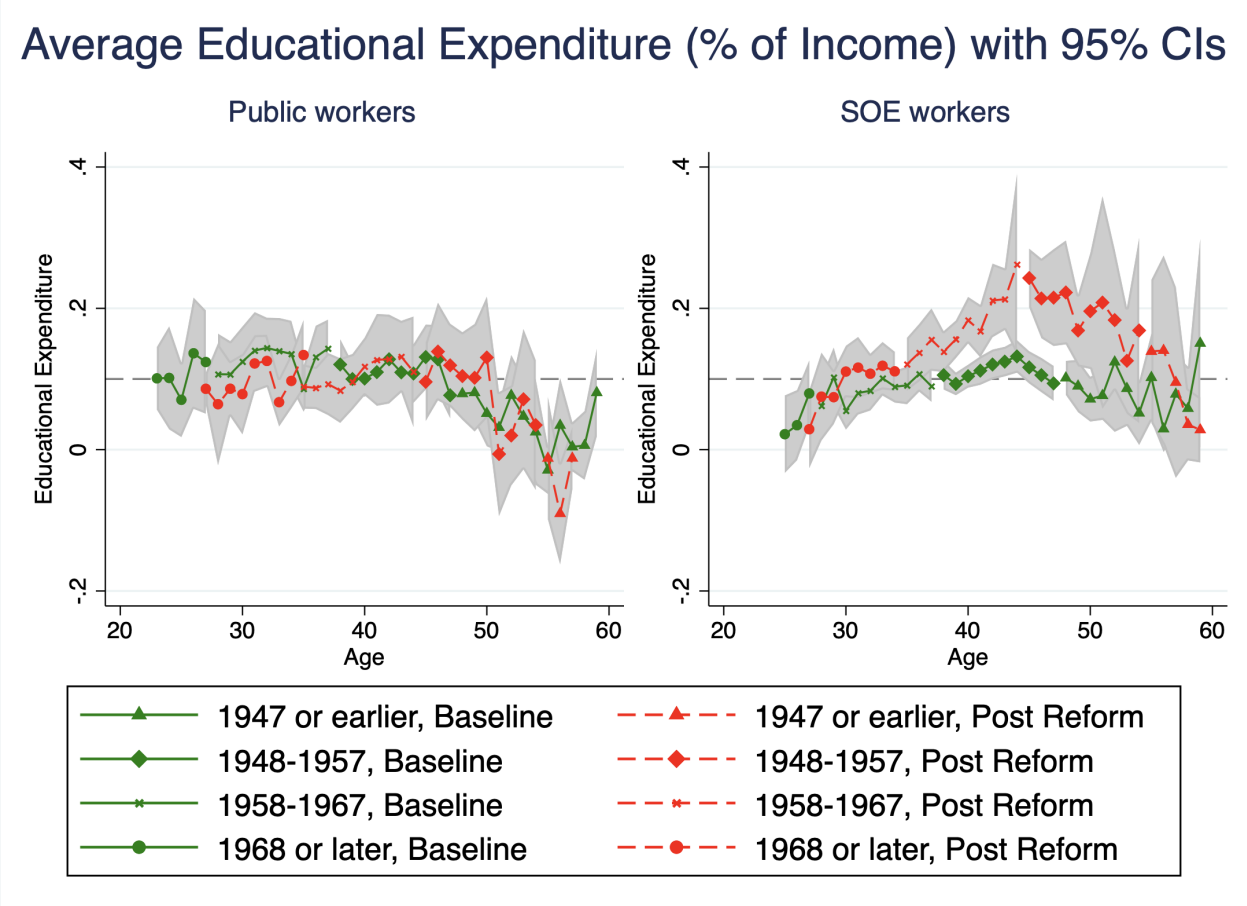

Figure 4: Education Expenditure (% of Income) with 95% CIs

of public workers does not change significantly, consistent with the fact that their pension benefits stay the same after the reform. SOE workers, however, increase their education expenditure on their children as their pension benefit decreases. Focusing on the middle age, we see that younger cohorts (born between 1958 and 1967) increase their education expenditure more than older cohorts (born between 1948 and 1957). This finding is consistent with the fact that the pension benefit of the younger cohorts decreases more. The results support our previous findings.

4.4.3 Child Investment

In this section, I examine the robustness of the effects on child investment. First, I restrict the sample to cohorts born after 1948, who are more restricted by the one-child policy

(OCP). The OCP was implemented in the late 1970s. Cohorts born before 1948 reached age 30 in the late 1970s and have made fertility choices. The fertility choices of younger cohorts are restricted by the OCP. Using the sample with younger cohorts, I can correct for the endogeneity problems from simultaneous decisions of fertility and child human capital investment. Second, I separate the samples into different age groups of parents to examine the life-cycle effects. I separate the sample into two groups: young (ages 25-39) and old (ages 40-50) groups. Third, I examine the effects on children of different ages by separating the samples into two groups according to children's age. One includes households with children of middle school age or below (ages 6-15). The other includes households with children of high school or college age (ages 16-23).

Panel 2 in Table 11 shows the results with a sample of younger cohorts. The education expenditure of SOE workers increases by 2% of their income. Young children of SOE workers enroll less in school, whereas older children enroll more in college. Compared to the benchmark sample, both the signs and levels of the estimates are consistent. This shows that using the sample of households with only one child can correct the endogeneity problem of simultaneous decisions of fertility and human capital investment. Panels 3 and 4 in Table 11 show the results of households at different ages. Younger households (ages 25-39) increase their education expenditure on their children. But their children's school enrollment decreases. Data about the college enrollment of children are not available at their age. For older households (ages 40-54), education expenditure and the school enrollment of children below college age do not increase significantly. But the college enrollment of children increases. I then examine the effects on children of different ages. Table 12 shows that investment in older children increases more than that in younger children. The education expenditure on older children increases by 3% of income compared to 1% on younger children. The school enrollment of younger children decreases by 4.8%, but the school enrollment of older children increases by 9.2%. This finding supports the life-cycle hypothesis. Older children are close to providing support for retired parents. Therefore, they receive more investment when pension benefits

decrease.

4.4.4 SOE Reform and Precautionary Savings

In this section, I examine the precautionary savings motives resulting from SOE reform in the late 1990s. The SOE reform led to massive layoffs in the SOE sector. He et al. (2018) find that the unemployment risks induced by the SOE reform and precautionary savings motives led to a large increase in financial wealth accumulation. I control for the precautionary saving motives from the SOE reform by constructing a variable measuring the layoff risk of each household. Following Appleton et al. (2002), I first estimate the probability of layoff as a function of household characteristics, such as age, gender, ethnicity, marital status, occupation, and so on. Second, I construct the layoff risk using the predicted probability. Third, I add the layoff risk in the control.

Table 13 compares the results of household savings with and without controlling for the layoff risks. Focusing on columns (2) and (4), we see that the coefficients of layoff probability are positive, which means layoff risks increase household savings significantly. This finding is consistent with the precautionary savings motives. Comparing the coefficients of the intersection between the treatment and post dummies in odd- and even-numbered columns, we see that the increase in household savings is greater (4,914 vs. 4,344 in levels, 0.70 vs. 0.49 in ratios) after controlling for the layoff risks. This result suggests that savings motives from a decrease in pension benefits are more important after controlling for precautionary savings.

Table 14 and Table 15 compare the results of educational expenditure in children and school attendance with and without controlling for the layoff risks, respectively. The positive coefficients of the probability of layoff indicate that households increase child investment after facing layoff risks. Comparing the school enrollment of children at different ages, we see that the probability of layoff is positively related to college attendance but negatively related to school attendance before college, indicating that children may provide insurance against

income risk. When we compare child investment in the odd- and even-numbered columns, we see that education expenditure and college attendance increase more after controlling for layoff risks. School attendance prior to college decreases more after controlling for layoff risks. This finding shows that the child investment motive following a decrease in pension benefits is more important after controlling for the precautionary savings motive.

5 Model

To better understand the empirical findings and results from the previous section, I now develop an overlapping generations model featuring intergenerational linkages and a pay-as-you-go pension system. I first describe the model framework and illustrate the mechanisms through which pension benefits affect child investment using the model solutions. Next, I calibrate the model using microdata to study the effects of pension reform quantitatively.

5.1 Model Overview

5.1.1 Timeline

The model is based on the framework in Choukhmane et al. (2013) with some extensions. As shown in Figure 5, I assume households live for four stages, which can be represented by childhood(c), parent(p), middle age(m), and retirement(r). In the childhood stage, households make no decisions and form their human capital by receiving support from their parents. During the parent stage, households can choose the number of children and the amount of investment in them. In the middle-age stage, households stop supporting their children and transfer part of their income to their parents to help support them. In the retirement stage, they receive transfers from their children and will die at the end of this stage. To simplify, I assume there are no uncertainties in death and no bequests when households die.

One key feature of the model is intergenerational linkages. The investment of young parents is important to children's subsequent income, and when children grow up, they

in turn help support their parents during their retirement stage. The amount of adult children's income determines their ability to provide support to retired parents. This gives young parents incentives to invest in their children.[29]

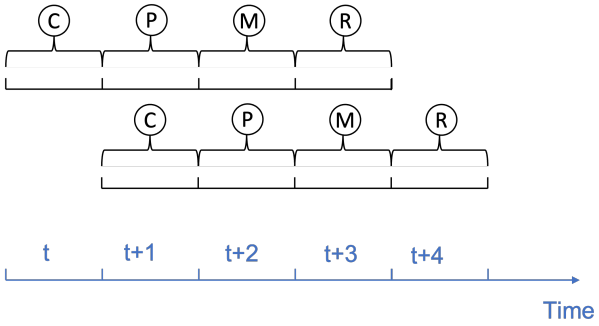

Figure 5: Timeline of Life Cycles

Preference. Households value their own consumption and also receive utility from having children. Specifically, the lifetime utility of a household at time t can be expressed as

$$U_t = u(c_t^p) + u(n_t) + \beta u(c_{t+1}^m) + \beta u(c_{t+2}^r), \tag{7}$$

where $u(n_t)$ is the utility from having n_t children. I assume $u(n_t) = \nu_c log(n_t) + \nu_t$, where ν_t is a random preference shock of fertility.

Human capital production. Households finish their education and form their human capital by the end of their childhood. They have no choice regarding the investment of their human capital. Instead, their parents choose the amount of investment, which determines their future earnings. As shown in Equation (8), I assume the human capital of households depends on the investment from their parents during childhood and has been fixed since the parent stage, given by

[29]Most of the literature related to child investment considers altruism toward children as an incentive. In this paper, I follow the assumption of selfish or non-altruistic parents to simplify the model. The incentive of parents to invest in their children comes from the future support from children when the parents retire. See Baland and Robinson (2002) for a detailed discussion.

$$h = \theta_h(i^c + \gamma_h)^{\rho_h}, \tag{8}$$

where θ_h represents the technology of investment in human capital, γ_h captures the human capital at birth without any investment, i^c represents the human capital investment by parents, and $\rho_h < 1$ represents the diminishing marginal returns in investment in human capital.

Earnings process. Considering a household at time t with human capital h, with earnings determined by

$$y_t = w_t \epsilon_j h \eta_j, \tag{9}$$

where w_t is the average wage rate, ϵ_j is the age component of earnings, $j \in (p, m)$ represents the parent stage and middle stage, respectively, and h is the human capital component of earnings. The term η_j is the stochastic idiosyncratic income shock, the log of which is an AR(1) process with an $i.i.d$ innovation as follows:

$$log(\eta_j) = \rho log(\eta_{j-1}) + \varepsilon_j,\ \varepsilon \sim N(0, \sigma_\varepsilon). \tag{10}$$

5.2 Household Problems

5.2.1 Childhood stage

During the childhood stage, households are supported by their parents and make no decisions. Their parents decide the amount of their consumption and investment i^c in their human capital. Households finish their education and form their human capital during the childhood stage. To simplify, I assume human capital is fixed during later stages.

5.2.2 Parent stage

At the parent stage, households earn income y calculated by Equation (9). The most important decisions they need to make are the level of fertility and the amount of child investment.

Households receive utility from having children but also bear the cost of supporting the children's consumption and education.

More specifically, at the beginning of the parent stage, households realize their income shocks η and fertility preference shocks ν_n for $n \in \{0, 1, 2, 3\}$. Conditional on the two shocks, their human capital level h, and their initial assets a, they choose their consumption c and savings a', plus the number of children $n \in \{0, 1, 2, 3\}$ and the amount of investment in each one i. To simplify, I assume the amount of investment in each child is the same.

I solve this stage in two steps. First, the household chooses the number of children after the realization of the household income shock and fertility preference shock by solving

$$V^p(a, \eta, h, n_s, n_{n=0,1,2,3}) = E[\max_n \{\tilde{V}^p(a, \eta, h, n) + 1_{\{n=0\}}\tilde{\nu}_0 + \sigma_n \nu_n\}], \tag{11}$$

where$\tilde{V}^p$ is the child-specific utility value function defined later; ν_0 is a constant representing the utility (or disutility if $\nu_0 < 0$) of having no children; and σ_n is the standard deviation of the fertility preference shock. The term h is the human capital of the household, and n_s is the number of siblings in the household.

Assume $p(a, \eta, h, n)$ to denote the probability of a parent with state (a, η, h, ν_n) choosing to have n children. Following Hua (2021), I assume the fertility preference shock ν_n follows a normalized Type 1 Extreme Value distribution with location 0 and scale 1. This assumption allows the probability of having each number of children $p(a, \eta, h, n)$ and the value function of parent stage V^p to be expressed in a closed form in terms of $\tilde{V}^p$ as follows: [30]

$$p(a, \eta, h, n_s, n) = \frac{exp[(\tilde{V}^p(a, \eta, h, n_s, n) + 1_{\{n=0\}}\tilde{\nu}_0)/\sigma_n]}{\sum_{n=0}^{4} exp[(\tilde{V}^p(a, \eta, h, n_s, n) + 1_{\{n=0\}}\tilde{\nu}_0)/\sigma_n]} \tag{12}$$

[30]This assumption is useful for adding altruism toward the utility of children in future work. Currently, I assume parents are selfish. The motivation of investment in the human capital of children comes from future transfers when parents retire. A large literature argues that parents care about the utility of children and therefore invest in their human capital. To simplify the model, I do not consider this altruism in the current version of the paper.

$$V^p(a,\eta,h,n_s,n) = \sigma_n[\gamma + ln(\sum_{n=0}^{4} exp[(\tilde{V}^p(a,\eta,h,n_s,n) + 1_{\{n=0\}}\tilde{\nu}_0)/\sigma_n])] \tag{13}$$

After the number of children n is determined, the household chooses the level of investment i^c in each child's human capital, savings a', and consumption c by solving

$$\tilde{V}^p(a,\eta,h,n_s,n) = \max_{c,a',i^c} u(c) + \nu_c log(n) + \beta^p E\left[V^m(a',\eta',h,n_s,n,h_c)\right] \tag{14}$$

subject to

$$c[1+\delta(n)] + a' + n \times i^c = (1+r)a + y(1-\tau_{ss}) \tag{15}$$

$$h_c = \theta_h(i^c + \gamma_h)^{\rho_h} \tag{16}$$

$$a' \geq 0 \tag{17}$$

$$i' \geq 0 \tag{18}$$

where τ_{ss} is the social security tax, and h_c represents the human capital of children.

5.2.3 Middle-age stage

Households at the middle-age stage no longer support their children. Instead, they need to support their retired parents by transferring part of their income to them. I assume the transfer is a function of their income and the number of siblings. The decisions households need to make at this stage are consumption and savings after the realization of income shocks.

The household problem at the middle-age stage is as follows:

$$V^m(a,\eta,h,n_s,n,h_c) = \max_{c,a'} u(c) + \beta^m E[V((a',\eta',h,n_s,n,h_c))] \tag{19}$$

subject to

$$c + a' + q^m = (1 + r)a' + y(1 - \tau_{ss}) \tag{20}$$

$$a' \geq 0 \tag{21}$$

where q^m represents transfers to retired parents, which is determined by their income and the number of siblings. Following Choukhmane et al. (2013), I assume there is a linear relationship between transfers and income, which is expressed as follows:

$$q^m = \phi_n \frac{(n_s)^{\omega-1}}{\omega} y(1 - \tau_{ss}) \tag{22}$$

where n_s represents the number of siblings, and $\omega \in (0, 1]$ represents the degree of free-riding among siblings who share the responsibility of taking care of the parents. I assume that transfers to parents are (weakly) decreasing in the number of children following Choukhmane et al. (2013). [31]

The expression $\phi_n > 0$ represents the positive relationship between transfers to parents and household income. Households with higher income give more transfers to their retired parents at the middle-age stage. Considering that income is determined by the human capital of households, that means households with higher human capital give more transfers to retired parents.

5.2.4 Retirement stage

The retirement stage is the last stage of the life cycle. Currently, I assume they will die with certainty in the next stage and there is no bequest motive, which means they will consume all the resources they own before they die. At this stage, households stop working and

[31] See Boldrin and Jones (2002) for details of a model that shows ascending transfers decrease in the number of siblings. In my empirical estimation using CHARLS data, transfers to parents from adult children are positively correlated with the number of siblings. However, I keep the assumption of a negative relationship $\omega < 1$ to prevent the transfers that parents receive from exploding with the number of children.

receive pension benefits and children's transfers. They need to make decisions about their consumption and saving by solving the following:

$$V^r(a, \eta, h, n_s, n, h^c) = \max_c u(c) \tag{23}$$

subject to

$$c = (1 + r)a + ss + q^r \tag{24}$$

$$q^r = \phi_n \frac{(n)^\omega}{\omega} y(1 - \tau_{ss}) \tag{25}$$

Social security ss_t^r is determined as follows:

$$ss = \theta Q_r, \tag{26}$$

where $\theta > 0$ represents the replacement ratio of pension benefits, and $Q_r = y_m$ represents the wage before retirement. A larger θ means a more generous pension. A more generous pension increases income at the retirement stage and, from a life cycle perspective, also increases lifetime income.[32]

5.3 Mechanisms

In my empirical work, I have shown that decreases in pension benefits positively affect savings and child investment. In this section, I discuss the model mechanisms that can capture this positive impact.

The key feature in the model that links pension benefits with child investment is intergenerational transfers. When households retire, they can receive transfers from children to help support them. Children serve the same role as pensions or private savings at the retire-

[32]This is a simplified pension system from He et al. (2017), which precisely models the two components of the Chinese pension system: defined benefit and defined contribution. I will later add these components to run counterfactual analysis of future pension reforms.

ment stage. Therefore, at the parent stage, households treat children as a savings tool for retirement. The trade-offs are savings, fertility, and investment in the human capital of children. To illustrate the mechanisms, I use a simplified version of the model abstracted from uncertainties, such as income shocks and fertility preference shocks, and discuss a scenario that includes a decrease in pension benefits.

The decisions regarding fertility and child investment are made at the parent stage. Therefore, I focus on the household problem at the parent stage to analyze the impacts of pension benefits. Following Hua (2021), to show the trade-offs at the parent stage, I calculate the first-order conditions in terms of fertility n, investment in the human capital of children i_c, and savings a' at the parent stage. To illustrate the effects, I extend the first-order conditions with partial derivatives from the maximized household problem at the middle-age stage or retirement stage.[33]

$$a' : \ \lambda = \beta^p \frac{\partial V^m(a', h, n_s, n, h_c)}{\partial a'} = \beta^p \lambda^m (1 + r), \tag{27}$$

where λ and λ^m represents the Lagrange multiplier of budget constraints for the household problem at the parent and middle-age stage respectively.

$$i^c : \ \lambda n = \beta^p \frac{\partial V^m(a', h, n_s, n, h_c)}{\partial h_c} \frac{\partial h_c}{\partial i^c} = \beta^p \beta^m \frac{\partial V^r}{\partial h_c} \frac{\partial h_c}{\partial i^c}, \tag{28}$$

where β^m is the discount factor of the middle-age stage and $\frac{\partial V^r}{\partial h_c} \frac{\partial h_c}{\partial i^c}$ represents the partial derivative of the investment in human capital of children for the maximized value function at the retirement stage.

$$n : \ \lambda c[\delta'(n)] + i^c = \beta^p \frac{\nu_c}{n} + \frac{\partial V^m(a', h, n_s, n, h_c)}{\partial n} = \beta^p \frac{\nu_c}{n} + \beta^p \beta^m \frac{\partial V^r}{\partial n} \tag{29}$$

where β^m is the discount factor at the middle-age stage and $\frac{\partial V^r}{\partial n}$ represents the partial derivative of the number of children for the maximized value function at the retirement stage.

[33] Appendix C.1 shows the details of the calculation.

Equation (27) shows how pension benefits affect household saving decisions. The left-hand side shows the marginal cost of savings, and the right-hand side shows the marginal benefit of savings. The marginal benefits reflect the shadow price λ^m of budget constraints at the middle-age stage.[34] When pension benefits increase, households have more resources to consume at retirement, which means households need less savings from the middle-age stage. Therefore, households at the middle-age stage have more resources to consume, which leads to a lower shadow price of the budget constraint. We can also think about this from a life cycle perspective. Households at the middle-age stage are making choices about both consumption today and consumption tomorrow at retirement given the budget constraint. If pension benefits increase, households have more resources to consume at the middle-age stage. Therefore, the shadow price of the budget constraint at the middle-age stage decreases, which in turn decreases the marginal benefits of savings at the parent stage—that is, it shifts the marginal benefit curve downward, leading to less savings at the parent age.

Equation (28) shows the trade-offs of parents in choosing the amount of investment in the human capital of each child. Since I assume there is no altruism toward the utility of children, the marginal benefit of investment in children (on the right-hand side) comes from the future transfers from children to households at the retirement stage $\beta^m \frac{\partial V^r}{\partial h_c} \frac{\partial h_c}{\partial i^c}$. This is derived from the maximization problem of the middle-age stage in Equation (40). The marginal cost of investment in each child depends on the number of children: the more children, the higher the marginal cost. This trade-off is similar to the "quantity-quality trade-off." Even given the same number of children, when pension benefits increase, households have more resources to consume at the retirement stage. When pension benefits increase, households have more resources to consume at retirement, which in turn decreases the marginal benefits at any level of the human capital of children. In other words, it shifts the marginal benefit curve downward. Put another way, households have fewer incentives to invest in the human capital of their children. Both of these effects lead to an increase in pension benefits having

[34] This is derived from the household problem at the middle-age stage.

a negative effect on child investment. [35]

Equation (29) can explain parents' decision regarding fertility when they face an increase in pension benefits. Similarly, the left-hand side shows the marginal cost of fertility, and the right-hand side shows the marginal benefit of fertility. It has opposite effects on fertility when pension benefits change. First, pension benefits increase income at the retirement stage as well as increase lifetime income. When income increases, households increase their consumption c. Children's consumption is a fraction of the consumption of households at the parent stage, meaning that on the extensive margin, the marginal cost of having children increases. Second, from the analysis above, we know that an increase in pension benefits leads to less investment in each child i^c. Therefore, on the intensive margin, the marginal cost of having children decreases. Third, the last component of the marginal benefit of having an extra child comes from receiving transfers from children at the retirement age of households. Similar to the discussion above, when pension benefits increase at the retirement stage, households have more resources to consume. This leads to a decrease in the marginal benefit of any number of children, which means the marginal benefit curve shifts downward. Overall, an increase in pension benefits has an ambiguous effect on fertility. The marginal benefits decrease, whereas the marginal costs may increase or decrease, depending on the degree of changes in consumption c and child investment i^c.

6 Calibration

In this section, I briefly introduce my plan to calibrate the parameters of the model. The main calibration results and analysis will be in the next version of the paper.

Table 16 shows the parameters and the datasets I plan to use. The most important parameters are the ones related to human capital investment and fertility choices. I plan to calibrate those parameters internally using the CHIP dataset, which includes information

[35] Much of the literature models child investment through altruism toward children's utility. In this paper, I abstract from that mechanism to focus on the motive of saving for retirement. In future work, I would like to discuss the role of the two effects and which is more important.

about the education expenditure on the children and the number of children. This information is useful for determining the parameters related to human capital. The parameters related to costs and fertility preferences use the information on the number of children. One caveat to keep in mind when calibrating the parameters related to fertility is that households are restricted by the one-child policy. I will need to use minorities, households born before 1950, or households in rural areas to pin down the parameters of fertility preference.

For the parameters estimated externally, I plan to estimate the wage process and transfer function using data from CHNS and CHARLS separately. I plan to borrow the other parameters from the literature or arrangements of the pension system.

7 Conclusion

In the empirical work, I provide evidence that a change in pension benefits will affect working-age households' savings and investment in children. I exploit the variation in the change in pension benefits in different work units resulting from the 1997 pension reform to address the empirical challenges that threaten causal inference.

The difference-in-differences estimates show that working-age households with a reduction in pension benefits will increase their savings and investment in children to ensure old-age security. Additionally, I do find that pension income will crowd out transfers from children to the retired and find a positive correlation between children's transfers and the number of children or their education level. These findings are consistent with the framework that households can secure their old age through investment in children when pension benefits change.

This work is incomplete and ongoing. I then develop an overlapping generations model with endogenous fertility and human capital investment choices to examine the effects of pension reform. The model is featured by intergenerational linkages between parents and children and a pay-as-you-go (PAYGO) pension system. The parental choices of child invest-

ment are important for a child's subsequent outcomes. Children in turn support parental retired life, which is a function of their income. Support from children gives incentives for parents to invest in their children. When the pension benefit changes, the child investment motive decreases.[36] The next step is to calibrate the model and run a counterfactual analysis to examine the effects of pension reform.

[36]Baland and Robinson (2002) discuss this "rotten parents" theory.

Table 2: Summary Statistics by Year and Sectors

	Public			SOE		
	1995	1999	2002	1995	1999	2002
Age	41.59	43.25	42.49	42.47	43.86	43.65
	(9.08)	(8.51)	(7.68)	(8.27)	(7.74)	(7.14)
Female	0.34	0.29	0.30	0.37	0.36	0.26
	(0.47)	(0.46)	(0.46)	(0.48)	(0.48)	(0.44)
Married	0.98	0.95	0.96	0.96	0.96	0.97
	(0.13)	(0.21)	(0.20)	(0.19)	(0.20)	(0.16)
Number of children	1.08	0.93	0.95	1.08	0.95	0.95
	(0.61)	(0.50)	(0.48)	(0.56)	(0.46)	(0.45)
Child age	10.88	12.15	12.04	12.11	13.28	13.33
	(7.60)	(8.41)	(7.73)	(7.37)	(7.83)	(7.66)
Homeowner	0.45	0.74	0.85	0.41	0.62	0.77
	(0.50)	(0.44)	(0.36)	(0.49)	(0.49)	(0.42)
Financial wealth(W)	10.65	24.01	35.53	9.94	19.27	31.26
	(10.83)	(24.46)	(33.68)	(10.66)	(21.50)	(32.38)
Household income	15.05	21.45	26.20	13.90	17.16	21.74
	(6.07)	(9.05)	(10.78)	(6.24)	(8.72)	(10.66)
Consumption	12.21	15.29	17.16	11.41	12.80	14.93
	(5.66)	(7.43)	(8.77)	(5.30)	(6.52)	(8.65)
Education expenditure	0.59	1.02	1.81	0.57	0.98	1.62
	(0.68)	(1.19)	(2.10)	(0.67)	(1.18)	(1.98)
Education						
Primary School and Below	0.02	0.01	0.01	0.08	0.04	0.03
	(0.15)	(0.10)	(0.08)	(0.28)	(0.19)	(0.18)
Middle School	0.14	0.15	0.10	0.38	0.38	0.30
	(0.35)	(0.36)	(0.31)	(0.48)	(0.49)	(0.46)
High School	0.39	0.30	0.32	0.39	0.38	0.43
	(0.49)	(0.46)	(0.47)	(0.49)	(0.48)	(0.49)
College or above	0.44	0.54	0.57	0.15	0.20	0.24
	(0.50)	(0.50)	(0.50)	(0.36)	(0.40)	(0.43)
Health Care						
Public Health care	0.79	0.88	0.42	0.68	0.61	0.34
	(0.40)	(0.33)	(0.49)	(0.47)	(0.49)	(0.47)
Public health insurance	0.03	0.05	0.41	0.11	0.16	0.44
	(0.18)	(0.21)	(0.49)	(0.32)	(0.36)	(0.50)
Own payment	0.17	0.07	0.17	0.21	0.23	0.22
	(0.38)	(0.26)	(0.38)	(0.40)	(0.42)	(0.41)
N	1550	657	1227	3371	1874	1634

Data are from CHIP surveys. Monetary values are in thousand constant Chinese yuan units, with 2002 as the base year.

Table 3: Fraction of SOE Workers

	1995	1999	2002
Panel A: Old definition			
SOE worker	0.64	0.63	0.36
	(0.48)	(0.48)	(0.48)
Public worker	0.31	0.25	0.28
	(0.46)	(0.43)	(0.45)
Panel B: New definition			
SOE worker	0.64	0.63	0.50
	(0.48)	(0.48)	(0.50)
Public worker	0.31	0.25	0.29
	(0.46)	(0.43)	(0.45)
Panel C: Broader definition			
SOE worker	0.64	0.68	0.61
	(0.48)	(0.47)	(0.49)
Observations	11735		

Note: This table compares fractions of public workers or SOE workers in all workers. Panel A defines types of workers according to the reported current working units. Panel B defines SOE workers as workers currently working in the SOEs plus workers laid off from SOEs but currently working in the private sector. Panel C defines SOE workers as workers currently working in the SOEs plus workers with any layoffexperience.

Table 4: Impact of 1997 Pension Reform on Household Saving

	Savings		Saving Rates	
	(1)	(2)	(3)	(4)
Treat X Post	4795.8*	4421.3***	0.426***	0.431***
	(2.40)	(2.26)	(0.107)	(0.109)
Observations	7550	7958	7903	8359
Control T0 Mean	10154.96	10154.96	1.36	1.36
Other controls	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes

Note: This table shows the effect of the 1997 pension reform on household savings using IV-Tobit regression in Equation 1. Odd-numbered columns use the new definition of SOE workers, including current SOE workers plus current private workers laid off from SOEs. Even-numbered columns use the broader definition of SOE workers, including current SOE workers plus workers with any layoff experience. All regressions include controls. The row of "Control T0 Mean" shows the means of outcomes of control group in the base year (1995). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Impact of 1997 Pension Reform on Child Investment

	Educational Expenditure				Educational Expenditure-Income Ratio			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treat X Post	77.304	51.997	78.028	61.428	0.014	0.016*	0.016*	0.017*
	(117.592)	(99.282)	(115.173)	(99.668)	(0.009)	(0.009)	(0.009)	(0.009)
Observations	3982	3592	4191	3771	3982	3592	4191	3771
Control T0 Mean	690.50	685.74	690.50	685.74	0.10	0.10	0.10	0.10
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child age: 6-18	No	Yes	No	Yes	No	Yes	No	Yes

Note: This table displays the effects of pension reform on educational expenditure on children by estimating Equation 1. Columns (1)-(2) and (5)-(6) use the new definition of SOE workers, including current SOE workers plus current private workers laid off from SOEs. Columns (3)-(4) and (7)-(8) use the broader definition of SOE workers, including current SOE workers plus workers with any layoff experience. Odd-numbered columns use the sample of households with children below age 23, which is the usual age to finish college in China. Even-numbered columns use the sample of households with school-age children, ages 6-18. All regressions include controls. The row of "Control T0 Mean" shows the means of outcomes of control group in the base year (1995). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Impact of 1997 Pension Reform on School Enrollment

	School-age Enrollment		College Enrollment	
	(1)	(2)	(3)	(4)
Treat X Post	0.004	0.010	0.027	0.090
	(0.021)	(0.021)	(0.090)	(0.096)
Observations	4123	4348	822	909
Control T0 Mean	0.90	0.90	0.32	0.32
Other controls	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes

Note: This table displays the effects of pension reform on school enrollment of children by estimating Equation 1. I use the sample of households with only one child, and the outcome variable is a dummy for school enrollment (=1). Columns (1)-(2) use samples of households with school-age children, ages 6-18. Columns (3)-(4) use samples of households with college-age children, ages 19-23. Odd-numbered columns use the new definition of SOE workers, including current SOE workers plus current private workers laid off from SOEs. Even columns use the broader definition of SOE workers, including current SOE workers plus workers with any layoff experience. All regressions include controls. The row of "Control T0 Mean" shows the means of outcomes of control group in the base year (1995). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Pension Coverage and Pension Benefits Across Cohorts

	Receive Pension		Log of Pension Income	
	(1)	(2)	(3)	(4)
Number of children	-0.043***	-0.039***	-0.314***	-0.321***
	(0.007)	(0.007)	(0.061)	(0.061)
1950 cohort	0.205***	0.124***	0.116	0.356
	(0.028)	(0.032)	(0.188)	(0.220)
1960 cohort	0.239***	0.050	-1.045**	-0.590
	(0.064)	(0.076)	(0.415)	(0.480)
Observations	3905	3905	4259	4259
Other controls	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	No	Yes
1940 cohort T0 mean	0.62	0.62	9.20	9.20

Note: This table displays the changes in pension coverage and pension benefits across cohorts by estimating Equation 3. Columns (1)-(2) use dummy of receiving pension after retirement (=1) as the outcome variable. Columns (3)-(4) use log of pension income after retirement as the outcome variable. I only use sample of retired households to study changes in pension coverage. For pension benefit changes, I further restrict the sample to households with any pension income. The row of "1940 cohort T0 Mean" shows the means of outcomes of cohorts of 1940 in the base year (2011). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Pension Income and Children's Transfers

	Receive Transfers		Log of Transfers	
	(1)	(2)	(3)	(4)
Dummy of receiving pension	-0.066**		-0.561***	
	(0.027)		(0.209)	
Log pension income		-0.005		-0.052**
		(0.003)		(0.024)
Number of children	0.078***	0.081***	0.645***	0.695***
	(0.022)	(0.024)	(0.179)	(0.193)
Observations	4718	4080	4630	4015
Other controls	Yes	Yes	Yes	Yes
Individual fixed effects	Yes	Yes	Yes	Yes

Note: This table shows the relationship between pension income and transfers from children for retired households by estimating Equation 4. Columns (1)-(2) use dummy of receiving transfers from children after retirement (=1) as the outcome variable. Columns (3)-(4) use log of transfers from children as the outcome variable. I restrict the sample to retired households with a positive number of children. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Children's Transfer and Education

	Send Transfers		Log of Transfers	
	(1)	(2)	(3)	(4)
Education(=1,2,3,4)	0.015**	0.015**	0.278***	0.288***
	(0.006)	(0.006)	(0.033)	(0.033)
Number of siblings	0.015***	0.013***	0.039**	0.044***
	(0.003)	(0.003)	(0.015)	(0.015)
Log labor income	0.003**	0.003**	-0.001	-0.001
	(0.001)	(0.001)	(0.005)	(0.005)
Observations	5936	5936	2085	2085
Other controls	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	No	Yes
Sample of positive transfers	No	No	Yes	Yes

Note: This table shows the relationship between transfers from children and their education level and number of siblings by estimating Equation 5. Columns (1)-(2) use dummy of sending transfers to parents (=1) as the outcome variable. Columns (3)-(4) use log of transfers from children as the outcome variable. All regressions include controls. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Robustness of Household Savings

	(1) Wealth	(2) Wealth-income Ratio
1. Benchmark	4795.78**	0.51***
	(2001.53)	(0.13)
2. Eliminating zero wealth	4039.53**	0.42***
	(1997.29)	(0.13)
3. Very liquid assets	4845.05**	0.51***
	(1947.80)	(0.13)
4. Non-housing non-business wealth	5070.44**	0.52***
	(2442.38)	(0.17)
5. Total assets with housing	-3281.67	0.81**
	(5356.00)	(0.41)
6. Age 25-39	5486.01**	0.45**
	(2314.84)	(0.22)
7. Age 40-54	4030.73	0.49**
	(3290.86)	(0.20)

Note: This table shows the results of a robustness check of the effects on household savings of pension reform by estimating Equation 1. Panel 1 shows the benchmark results using financial wealth as the outcome variable and the new definition of SOE workers, which includes current SOE workers plus current private workers laid off from SOEs. Panel 2 shows the results using the sample excluding households with zero wealth. Panels 3 and 4 show the results using VLA and NHNBW as the outcome variable, respectively. Panel 5 shows the results using total assets including housing as the outcome variable. Panels 6 and 7 show the results using samples of households at different ages (ages 25-39 and 40-54), respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Robustness of Child Investment

	(1) Education Expenditure	(2) Educational Expenditure-Income Ratio	(3) School-age Enrollment	(4) College-age Enrollment
1. Benchmark	155.43	0.02**	-0.03*	0.15*
	(103.99)	(0.01)	(0.02)	(0.09)
2. Sample more restricted by OCP	186.57*	0.02**	-0.04**	0.08
	(108.86)	(0.01)	(0.02)	(0.16)
3. AGE 25-39	238.78*	0.03**	-0.04	
	(122.70)	(0.01)	(0.03)	
4. Age 40-54	-76.58	0.01	-0.02	0.15
	(150.86)	(0.01)	(0.02)	(0.11)

Note: This table shows the results of a robustness check of the effects on child investment of pension reform by estimating Equation 1. Column (1) shows the results using educational expenditure as the outcome variable. Column(2) shows the results using the educational-expenditure-income ratio as the outcome variable. Column (3) shows the results using school enrollment of children ages 6 to 18 as the outcome variable. Column (4) shows the results using the college enrollment of children ages 19 to 23 as the outcome variable. Panel 1 shows the results of the benchmark regression using the sample of households with only one child. Panel 2 shows the results using the sample of households born after 1948, who are more restricted by the one-child policy. Panels 3 and 4 show results using the sample of households at different ages (ages 25-39 and ages 40-54), respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Compare Investment in Children of Different Ages

	Child Age: 6-15			Child Age: 16-23		
	(1) Education Expenditure	(2) Education Expenditure Income Ratio	(3) School Attendance	(4) Education Expenditure	(5) Education Expenditure Income Ratio	(6) School Attendance
Treat X Post	25.727	0.010	-0.048***	127.223	0.031*	0.092
	(104.378)	(0.009)	(0.018)	(225.278)	(0.018)	(0.061)
Observations	3112	3112	2910	1542	1542	1591
Control T0 Mean	632.16	0.09	0.96	685.09	0.09	0.60
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table shows the results of heterogeneous effects on child investment of pension reform by estimating Equation 1. Columns (1)-(3) show the results using households with children ages 6 to 15. Columns (4)-(5) show the results using households with children ages 16 to 23. "Control T0 Mean" shows the means of outcomes of control group in the base year (1995). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13: Household Savings with Layoff Risks

	Savings		Saving Rates	
	(1)	(2)	(3)	(4)
Treat X Post	4344.477**	4914.340*	0.491***	0.703***
	(1959.092)	(2676.423)	(0.130)	(0.204)
Risk	1116.325***	1126.811***	0.161***	0.179***
	(323.606)	(349.029)	(0.027)	(0.033)
Probability of Layoff		4894.150		1.433*
		(7358.023)		(0.740)
Observations	7581	7563	7581	7563
Other controls	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Control T0 Mean	10457.25	10457.25	1.39	1.39

Note: This table shows the results with and without the probability of layoff as a control in estimating Equation 1. The two outcome variables are savings, measured by financial wealth, and saving rates, measured by the wealth-income ratio. Odd-numbered columns show the results without the probability of layoff. Even-numbered columns show the results with the probability of layoff as a control. The row labeled "Risk" shows the coefficients of income volatility. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 14: Child Investment with Layoff Risks

	Education Expenditure		Education Expenditure-Income Ratio	
	(1)	(2)	(3)	(4)
Treat X Post	158.134	170.022	0.019**	0.021*
	(105.500)	(138.402)	(0.008)	(0.012)
Risk	71.295***	71.002***	0.009***	0.009***
	(17.560)	(18.276)	(0.002)	(0.002)
Probability of Layoff		144.178		0.023
		(439.760)		(0.046)
Observations	5452	5441	5452	5441
Other controls	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Control T0 Mean	611.43	611.43	0.09	0.09

Note: This table shows the results with and without the probability of layoff as a control in estimating Equation 1. The two outcomes are the educational expenditure on children and the ratio of educational expenditure to income. I restrict the sample to households with only one child. Odd-numbered columns show the results without the probability of layoff. Even-numbered columns show the results with the probability of layoff as a control. The row labeled "Risk" shows the coefficients of income volatility. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 15: School Attendance with Layoff Risks

	School-age Enrollment		College-age Enrollment	
	(1)	(2)	(3)	(4)
Treat X Post	-0.031*	-0.044*	0.152*	0.228*
	(0.018)	(0.024)	(0.092)	(0.121)
Risk	-0.002	-0.002	0.011	0.012
	(0.003)	(0.003)	(0.012)	(0.013)
Probability of Layoff		-0.084		0.595
		(0.082)		(0.380)
Observations	3715	3711	786	784
Other controls	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Control T0 Mean	0.95	0.95	0.32	0.32

Note: This table shows the results with and without the probability of layoff as a control in estimating Equation 1. The two outcomes are the school enrollment of children at ages 6 to 18 and the college enrollment of children at ages 19 to 23. I restrict the sample to households with only one child. Odd-numbered columns show results without the probability of layoff. Even-numbered columns show the results with the probability of layoff as a control. The row labeled "Risk" shows the coefficients of income volatility. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 16: Model Parameters

Function	Parameter	Description	Data or Source
Parameter estimated externally			
Utility	σ	Risk averse	Hua (2021)
	β	Discount factor	
Wage	ϵ_j	Age profile	CHNS
	σ_ε	Dispersion of shocks	
Transfer	ϕ_n	Fraction of transfer	
	ω	Curvature	CHARLS
Pension	τ_{ss}	Social security tax	He et al. (2017)
	θ	Replacement rate	
Consumption	δ_n	Cost of feeding children	CHIP
Parameter calibrated internally			
Human capital	θ_h	Scale	CHIP
	ρ_h	Curvature	
	γ_h	Fixed effects	
Fertility	σ_n	Dispersion of fertility shocks	CHNS
	ν_0	Utility or disutility of no child	
	ν_c	Utility of children	

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A Pension System

A.1 Pension Benefit Calculation

Before the 1997 pension reform, pension entitlement only includes the basic pension benefits. Those benefits depend on the individual wage and working years, calculated using the following formula:

$$Old\,Pension = Individual\,Wage \times Pension\,Multiplier$$

where pension multiplier is determined by the working age, ranging from ages 70 to 90.

After the 1997 pension reform, there is heterogeneity in pension benefit entitlements according to workers' working and retirement age. The pension benefits of the old workers follow the same rule as that in the pre-reform period. New workers' pension entitlements include two components: a basic pension benefit and an individual account. Middle workers have transitional pension benefits apart from the same basic pension and individual accounts as the new workers. The basic pension benefit depends on individual wage and contribution years. The benefit amount is also affected by the regional average wage. The formula is as follows:

$$Basic\,Pension = Equivalent\,Wage \times Contribution\,Years \times 1\%$$

where

$$Equivalent\,Wage = Regional\,Average\,Wage \times \frac{(1 + Indexed\,Individual\,Wage)}{2}$$

Pension benefits from individual accounts are determined by workers' contribution and retirement age. The accumulated balance in their individual account is converted into a stream of monthly pension payments at the time of retirement by dividing the balance by an annuity factor. The annuity factor is determined by the government and depends on individual retirement age and average national life expectancy. The formula to calculate individual account benefits is as follows:

$$Individual\,Accounts = \frac{Account\,Balance}{Annuity\,Factor}$$

The transitional pension benefit is designed to compensate for the loss in pension benefits under the new pension system of middle workers. It varies with individual wage and equivalent contribution years. The specific calculation formula is determined by local governments

and may vary across regions, but most of them follow this formula:

$$Transitional\,Pension = Equivalent\,Wage \times Transitional\,Multiplier \times Contribution\,Years$$

where transitional multiplier lies between 1% and 1.4% in general.

$$Equivalent\,Wage = Regional\,Average\,Wage \times \frac{(1 + Indexed\,Individual\,Wage)}{2}$$

Note the pension arrangement of the laid-off SOE workers. A massive number of employees in SOEs lost their jobs during the SOE reform in the late 1990s. However, the contributions to the pension system from their employers and themselves continued as long as they did not end their contract with the enterprises despite being laid off.

A.2 Current Chinese Pension System

The current Chinese pension system is multi-layered. The first layer includes several public pension systems. It can be divided into two parts based on the types of participation: mandatory and voluntary. The mandatory part includes Basic Old Age Insurance and Public Employee Pension. The voluntary part includes Urban Resident Pension and New Rural Resident Pension. The public pension systems aim to provide basic social security for all residents when they are old, regardless of whether or not they were employed before. The second layer includes the employer-sponsored annuity programs, voluntarily provided by employers as a supplement to the public pension plan. The third layer is the household savings-based annuity insurance plan. The public pension systems receive substantial direct fiscal support, whereas all the systems or plans are tax preferred (Fang and Feng (2018)).

Table 17: Current Chinese Pension System

1st Layer	Basic Old-Age Insurance	Mandatory	1997
	Public Employee Pension	Mandatory	2015
	Urban Resident Pension	Voluntary	2011
	New Rural Resident Pension	Voluntary	2009
2nd Layer	Employer-sponsored annuity programs	Voluntary	
3rd Layer	Supplementary private pensions arranged by households	Voluntary	

The last column shows the reform time. The first two pension systems were established in 1951 and 1953, respectively, but the rules changed in 1997 and 2015. The last two were established during the reform time.

A.2.1 Basic Old-Age Insurance System (BOAI)

BOAI is the most important public pension system in China. It was established in 1951 for urban employees and formed a two-pillar system in 1997. It is a compulsory scheme with both defined-contribution and defined-benefit components. The first pillar is a defined-benefit plan. From the contribution side, it requires employers to contribute 20% of the wages paid to their workforce[37]. There is a boundary on the wage level that is subject to the pension contribution requirement, with 300% of the local average wage as the upper limit and 60% of the local average wage as the lower limit. The pension fund goes into the social account, managed by the local government. From the benefit side, employees with 15 years or more of credits, based on contribution years, are entitled to pension benefits. The replacement ratio depends on the number of years of contribution and the individual's wage relative to the local average wage. Based on the funding source and expense, the first pillar is a pay-as-you-go (PAYGO) pension system. Changes in the benefits have distributional effects across generations.

The second pillar of BOAI is a defined-contribution plan, which is a mandatory individual account pension. From the contribution side, it requires employees to contribute 8% of their wages, with the same wage boundary subject to the pension contribution requirement as the employers. The contributions go into the individual account. Beneficiaries cannot make any allocation decisions about how contributions to it are managed. From the benefits side, the accumulated balance in the individual account is converted into a stream of pension payments at the time of retirement. The benefits are calculated by dividing the balance by a government-determined annuity factor, which depends on individual retirement age and national life expectancy. Different from the first pillar, the individual account is a funded system. In some provinces, however, it is a notional account and is credited with a notional interest rate[38].

The BOAI retirement ages are 50 for female blue-collar workers, 55 for female while-collar workers, and 60 for males. The target replacement ratio published by the Ministry of Human Resources and Social Security (MOHRSS) of China is 59% (relative to the local average wage), 35% from the pooling account (basic pension), and 24% from the individual account.

A.2.2 Public Employee Pension (PEP)

The PEP is designed for civil servants and employees in the non-profit public sector. It was established in 1953 and is the most generous pension scheme, which does not require any contribution from the public employees. The average replacement ratio is 80%-90% of pre-retirement wages. The PEP expenditure is funded by the central government and local governments' fiscal budgets. PEP was reformed in 2015 and was merged with BOAI, with the contribution and benefit rules for public employees following BOAI. However, there is a transitional arrangement for current public workers. For those who retired before the 2015 reform, pension benefits are unchanged. For those who joined the public sector after 2015 reform, the pension will follow BOAI. For those who are in the public sector and will retire after the 2015 reform, the individual accounts and pension benefits will use the transitional rules.

The PEP retirement eligibility age is 55 for females and 60 for males.

A.2.3 New Rural Resident Pension (NRP) and Urban Resident Pension (URP)

The NRP was established in 2009 to cover rural residents, and the URP was established in 2011 to cover urban non-employed residents. The two systems were merged into a uniform Resident Pension system in 2014. They are both voluntary and funded with government subsidies. Individuals can choose the contribution amount, which goes into individual accounts. The level of contributions depends on local economic conditions and varies across regions as well as between rural and urban residents. Pension benefits include two parts: a basic pension and the individual account. The basic pension is funded by the central and local government[39]. Its replacement ratio is about 20% (nationwide average) of rural per capita net income. Local governments can raise the basic pension benefits according to its economic conditions, but they are responsible for outstanding financial obligations. To collect pension benefits, participants need to have a contribution history of 15 years or more,

[38]The contribution rate of 20% from the employers is a standard suggested by the central government. However, the exact contribution rates are determined by the local government and can vary depending on the actual situation. For example, the contribution rate from employers for Guangzhou City is 12%. This contribution rate for Guangzhou City is considerably low because many younger migrants live in the city, and the aging problem is not so serious. The contribution rate for Shanghai is 22% from the employer because the aging problem in the population is more serious (Xu et al. (2017)).

[38]The three northeastern provinces and either other provinces have funded individual account systems. In other provinces, the accounts are largely notional.

and the retirement eligibility age for NRP and URP is 60 for both males and females.

A.2.4 Enterprise Annuity and Occupational Annuity

The employer-sponsored pension system (EA) was introduced in 1991. Employers voluntarily choose to offer defined-contribution (DC) plans in which they are not responsible for pension investments and returns. It is an underdeveloped market in terms of the low number of participants, low number of providers (enterprises), and pension assets. Private companies lack incentives to offer pension plans. Most of the enterprises offering pension plans are large state-owned enterprises (SOEs). Regulations and legislation play an important role in the development of the EA system[40].

The occupational annuity (OA, "zhi ye nian jin" in Chinese) was introduced into the public sector in 2015 as part of the PEP reform. It requires the public sector to provide OA as a complement to benefits. Employers need to contribute 8% of employees' wages, and employees contribute an additional 4%. Similar to the EA, they are all tax preferred. The difference is that individual accounts in the OA system are partly notional.[41]

A.2.5 Private Annuity Insurance

Annuity insurance has grown rapidly in China. Currently, 69 insurers are involved in the commercial annuity business. The average annual growth rate of annuity insurance is 16.9% between 2001 and 2014. However, many of the annuity insurance products are offered as wealth management products and are not intended to be in force for a long time. Therefore, it is unlikely to serve as a genuine source? of pension income. In 2018, a tax-preferred policy was introduced in some regions to encourage the private annuity program[42]. It provides tax deductions for individual premiums, not investment returns. Benefits are subject to income taxation when beneficiaries receive them at the eligible age.[43]

[39]In central and western provinces, the basic pension is entirely funded by the central governments, whereas in the eastern provinces, it is funded equally by central and local governments.

[41]In 2004, the central government issued two regulations on the EA system and its pension fund management. Favorable tax treatment has been in place on pension contributions and investment returns since 2014.

[41]In the OA system, the government employer's contribution to the individual account is notional. Some self-financed public sectors cannot afford the contribution, whereas the employee's contribution is fully funded in the individual accounts. The implementation of the OA system is still preliminary, with little information publicly available.

[43]The policy was introduced in Shanghai, Fujian Province and Suzhou industrial Park as a pilot program.

[43]There is an upper limit on the tax deduction, which is 6% of one's taxable income or 12,000 RMB. The annuity benefits also enjoy tax preferences, with 25% exempt from income taxation.

B Data

In this section, I discuss the data sets I use to examine the pension effects.

B.1 Chinese Household Income Project (CHIP)

The data I use to estimate the main result is from the Chinese Household Income Project (CHIP). It has conducted five waves of cross-sectional surveys to collect detailed information about household income and expenditure in 1988, 1995, 2002, 2007, and 2013. CHIP surveys rural and urban area separately with samples drawn from the census, which is nationally representative. In 2002, CHIP introduced the survey of migrants from rural to urban areas, as rural-to-urban migration became important and the sample did not adequately cover migrants. I restrict the sample to urban residents as I mainly study the effects of the 1997 pension reform, which targets workers in the urban area. I also exclude rural-to-urban migrants because they mainly joined the pension system of rural residents as a result of Hukou registration.[44] To study the effects of the 1997 pension reform, I use data from 1995 and 2002. I do not include the year 1988 because of an inconsistency in the definition of variables. An interim survey focuses on urban residents in 1999. I exclude the data from 1999 in the main results as the survey area is different and there are fewer observations than in the normal surveys. However, I do plan to add them in the robustness check.

CHIP provides information on individuals and households separately. I use household heads as representatives of the households and keep their demographics. Then I merge the data of individuals with that of households. I select the sample by three criteria. First, I select the sample to be working-age households, ages 23 to 59, following my research question. Second, I restrict the sample to labor force participants to represent the majority of households. Third, I exclude workers in the private sector in the main analysis because of few observations before the pension reform. The 1997 pension reform expands pension coverage to private workers, and the causal effects of pension reform can be identified by comparing private workers with public workers. I plan to add this later in the robustness check. I start with 13,766 observations and end up with 8,033 observations after applying the three-criteria filter. I further remove the observations with outliers of age, income, wealth, and education expenditure during the analysis.

B.1.1 Definition of Variables

In this section, I describe the definition of related variables in the CHIP dataset.

[44] Hukou is a household registration system based on the birth place, and it is hard to change. Social benefits are determined by the Hukou registration place and could not switch systems by then.

Household Permanent Income CHIP surveys the history of income of household heads but not of the whole households. To construct the measure of household permanent income, I assume that the income of households shares the same growth rate as the income of household heads. This assumption is reasonable given the fact that the largest source of household income is from the household head. I construct household permanent income in three steps. First, I calculate a yearly individual income index defined as the ratio of the income of household heads to the average income of all household heads in each year using reported annual income data. Second, I calculate the individual permanent income index of household heads by taking the average of the time series of the income index of household heads. Third, I calculate permanent household income by multiplying the individual permanent income index with average household income in each survey year. The assumption is that the permanent income index of the household head is the same as that of the whole household, which is implied by the assumption of the same growth rate.

Wealth I use the self-reported value of total financial assets in the CHIP survey as the main outcome variable. It includes checking accounts, savings accounts, bonds, stocks, contributions to employer funds, loans to others, and other types of financial assets. CHIP also provides information about the market values of durable goods, self-owned houses, and other valuable assets such as collections. I also constructed alternative commonly used measures of wealth as the sensitivity check following He et al. (2018). The first is very liquid assets (VLA), which only includes checking accounts, savings accounts, bonds, and stocks. Compared to financial wealth, long-term investments are excluded. The second is non-housing non-business wealth (NHNBW), which is the net wealth without housing. It contains financial assets, the estimated market value of durable goods, and other assets, minus total debts. The last measure is total assets including the estimated market value of housing. By using different measures, we can check if measurement errors of the dependent variable will be a problem.

Educational expenditure Educational expenditure is defined as the sum of expenditure on tuition and fees, educational materials, child care, and other related expenditure. Only expenditure on children's education is included.

B.1.2 SOE Reform and Definition of SOE Sector

The SOE reform was implemented in 1997 to improve efficiency of SOEs, which was losing in the competition with private firms. Massive bankruptcies and layoffs happened in the SOEs under the slogan of "grasp the large and let go of the small." "Grasp the large" means to transform large state-owned enterprises into profitable industrial conglomerates under the control of central governments. "Let go of the small" means to close or sell small state-owned

enterprises. Layoffs happened together with the transformation of SOEs.

The definition of SOE workers and public workers is important for the causal inference. Public workers are tenured or long-term workers in all levels of governments and public institutions. SOE workers are tenured or long-term workers in the enterprises owned by the state or local governments. The remainder of workers belong to the private sector.

The SOE reform leads to massive layoffs of SOE workers. As shown in Figure 6, the fraction of SOE workers decreased by 27 percentage points from 1995 to 2002. Without correcting the definition of SOE workers, the composition of the treatment group (SOE workers) changes. A concern here is that the survivors in the SOE reforms are potentially the ones with higher savings and pension benefits in any case. In a DID design, this selection of reform-induced SOE workers tends to make the pension reform less influential in terms of pension benefit changes than it really is. The problem can be fixed if we know the working units of laid-off workers before the reform and use that information to correct the definition of SOE workers. CHIP provides information on previous working units and workers' layoff experience. Using this information, I add the laid-off workers who previously worked in SOEs.

I use three sets of questions to redefine the SOE workers:

- Have you ever experienced a layoff before? What was the ownership of your working unit before the layoff?
- If you changed working units within three years, what was the ownership of your previous working unit? What was the reason for leaving your previous working unit?
- Did the ownership of your working unit change in the last ten years? If yes, what was its previous ownership?

SOEs are the working units defined as SOEs at the central level, provincial level, or local level, urban collectives, and state share-holding companies. After correction of SOE workers, the fraction of SOE workers increases to 51% in 2002, which is 13% less compared to the level of 1995. This mitigates the concern over the composition change mentioned above. Another way to fix the problem is to compare the survivors of the SOE reform with public workers using propensity score matching to select the survivors in 1995. This is my next step in the robustness check.

B.2 Other Graphs

Figure 7 plots the trends of consumption and income by treatment status (public sector or SOE sector). It shows that the trends of the two variables in the public sector and SOE

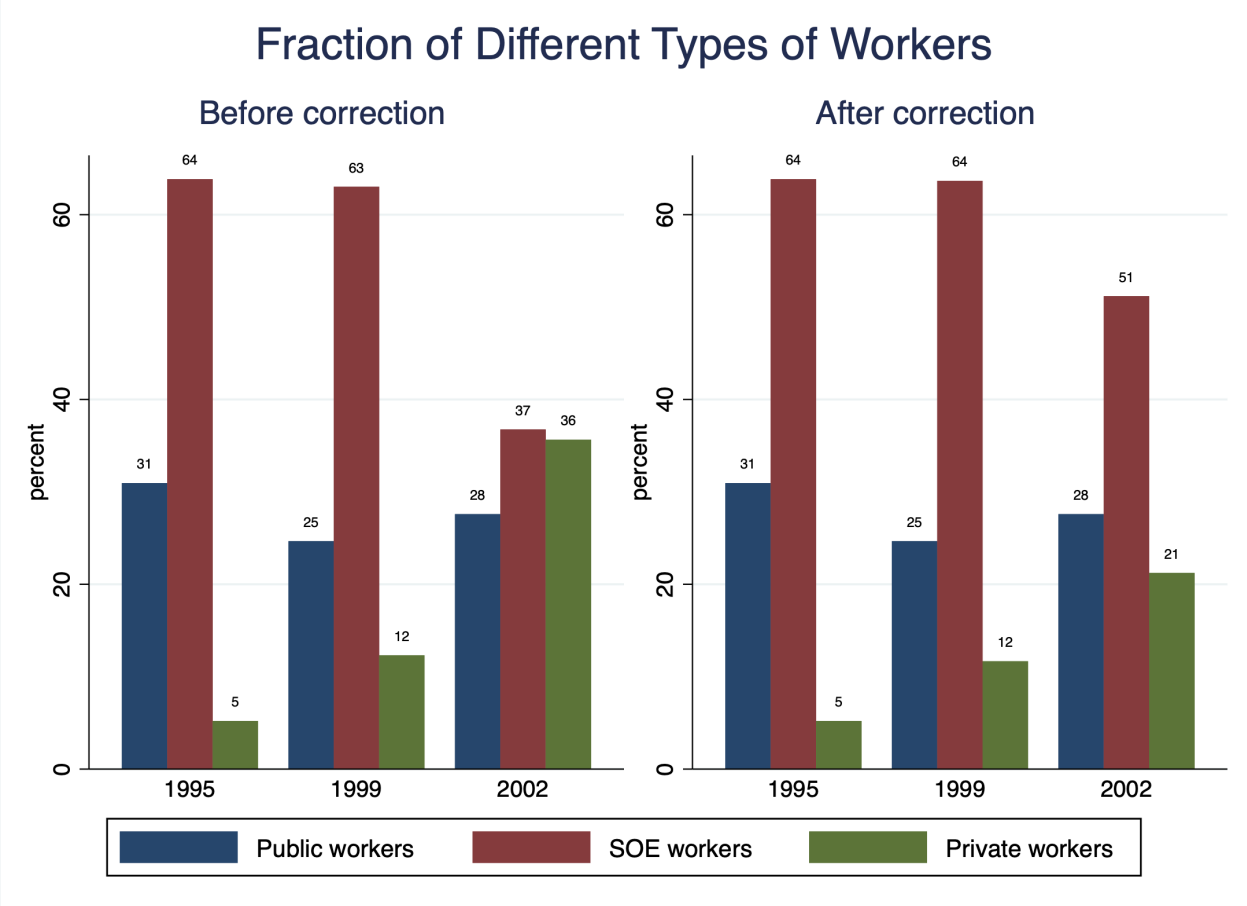

Figure 6: Fraction of Different Types of Workers

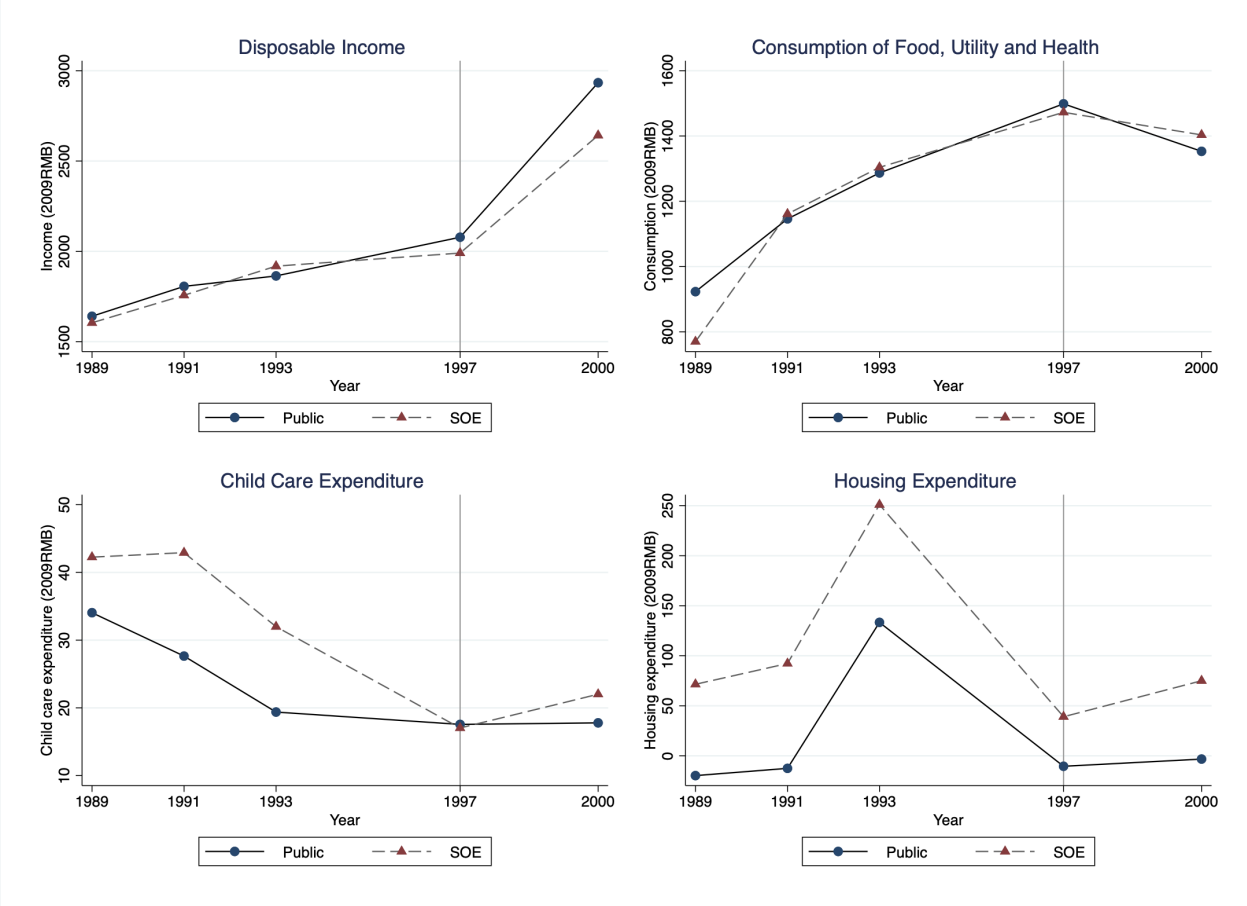

Figure 7: Pre-trends in Household Income and Consumption

sector seem to be similar in the pre-pension-reform period.

Figure 8 shows the average educational expenditure or school enrollment of children for the treatment and control groups at different ages. College enrollment is only available for over-40 households; therefore, I focus on households between the ages of 40 and 55 for the college enrollment rate.

C Model

C.1 Household Maximization Problems

In this section, I solve the first-order conditions of the simplified household problems in Section 5.3.

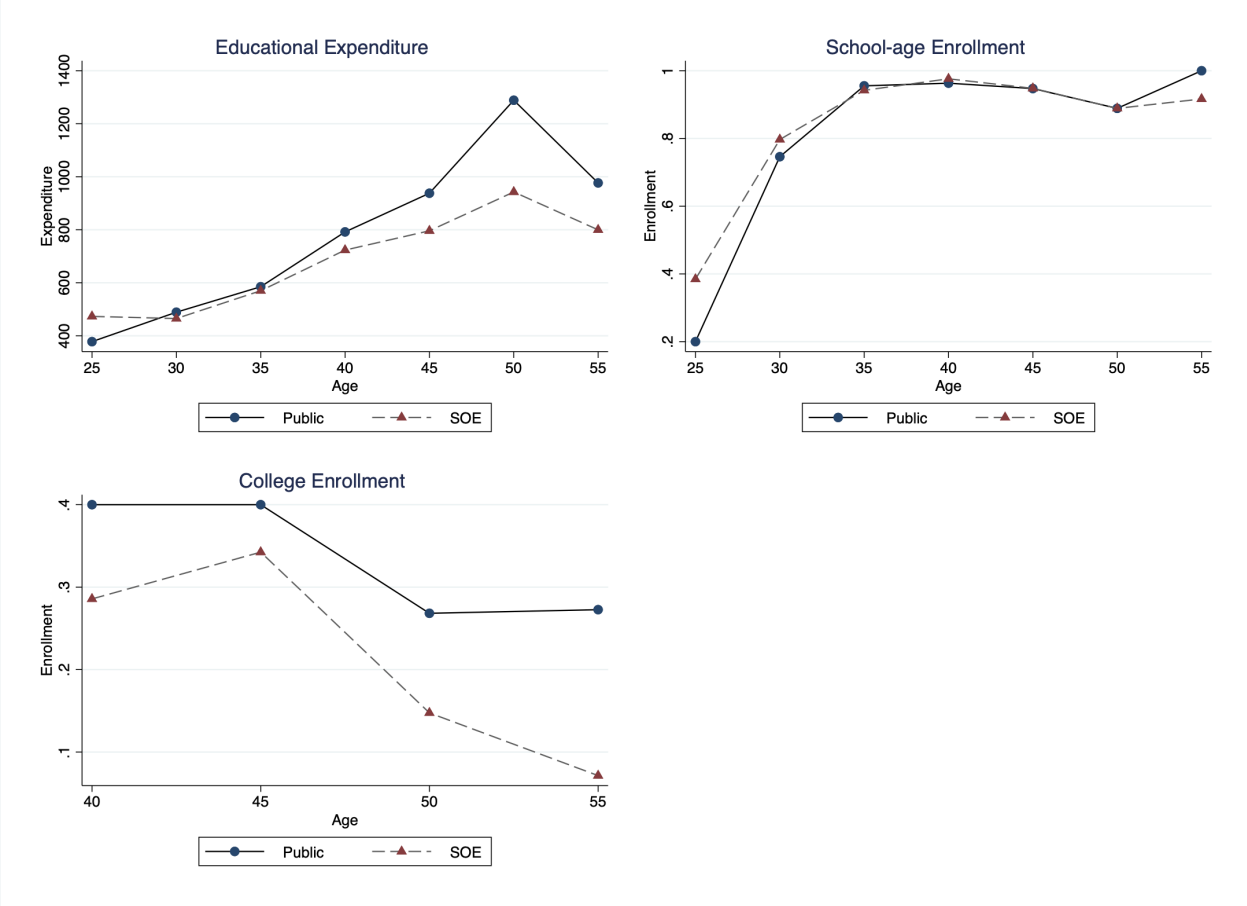

Figure 8: Pre-trends in Child Investment

C.1.1 Parent Age

The household problem at parent stage is:

$$\tilde{V}^p(a,h,n_s)) = \max_{c,a',i^c,n} u(c) + \nu_c log(n) + \beta^p E\left[V^m(a',h,n_s,n,h_c)\right] \tag{30}$$

subject to

$$c[1+\delta(n)] + a' + n \times i^c = (1+r)a + y(1-\tau_{ss}) \tag{31}$$

$$h_c = \theta_h(i^c + \gamma_h)^{\rho_h} \tag{32}$$

$$a' \geq 0 \tag{33}$$

$$i^c \geq 0 \tag{34}$$

The Lagrangian equation is:

$$\begin{aligned}\mathcal{L}(c,a',i^c,n|a,h,n_s) = \max_{c,a',i^c,n} & u(c) + \nu_c log(n) + \beta^p V^m(a',h,n_s,n,h_c) \\ & + \lambda_p((1+r)a + y(1-\tau_{ss}) - c[1+\delta(n)] - a' - n \times i^c) \\ & + \nu a' + \mu i^c\end{aligned} \tag{35}$$

The first order condition of c:

$$u'(c) = \lambda^p\left(1+\delta(n)\right) \tag{36}$$

The first order condition of a':

$$a' :\ \lambda = \beta^p \frac{\partial V^m(a',h,n_s,n,h_c)}{\partial a'} = \beta^p \lambda^m \tag{37}$$

The first order condition of i^c is:

$$i^c :\ \lambda n = \beta^p \frac{\partial V^m(a',h,n_s,n,h_c)}{\partial h_c}\frac{\partial h_c}{\partial i^c} \tag{38}$$

The first order condition of n is:

$$n :\ \lambda c[\delta'(n)] + i^c = \beta^p \frac{\nu_c}{n} + \frac{\partial V^m(a',h,n_s,n,h_c)}{\partial n} \tag{39}$$

C.1.2 Middle Age

The household problem at middle age is as:

$$V^m(a, h, n_s, n, h_c) = \max_{c,a'} u(c) + \beta^m V((a', h, n_s, n, h_c)) \tag{40}$$

subject to

$$c + a' + q^m = (1 + r)a' + y(1 - \tau_{ss}) \tag{41}$$

$$a' \geq 0 \tag{42}$$

The Lagrangian equation is:

$$\begin{aligned}\mathcal{L}(c, a'|a, h, n_s, n, h_c) = \max_{c,a'} u(c) + \beta^m V^r(a', h, n_s, n, h_c) \\ + \lambda_m((1 + r)a + y(1 - \tau_{ss}) - q^m - c - a') + \nu a'\end{aligned} \tag{43}$$

First-order condition of c is:

$$u'(c) = \lambda^m \tag{44}$$

First-order condition of a' is:

$$\lambda^m = \beta^m(1 + r)\frac{\partial V(a', h, n_s, n, h_c)}{\partial a'} \tag{45}$$

The partial derivative of a for the Lagrangian problem is:

$$\frac{\partial L}{\partial a} = \frac{\partial V^m(a', \eta', h, n, h_c)}{\partial a'} = \lambda^m(1 + r) \tag{46}$$

C.1.3 Retirement Age

The solution of the retired period is trivial because I assume there is no altruism and households die for sure in the end of this period. Therefore, households will consume all the resources they have. The state variables that matter in the period is the total resources to consume determined by savings a, pension benefits ss, and transfers from children q^r.

$$V^r(a, \eta, h, n_s, n, h^c) = \max_{c} u(c) \tag{47}$$

subject to

$$c = (1 + r)a + ss + q^r \tag{48}$$

$$q^r = \phi_n \frac{(n)^\omega}{\omega} y(1 - \tau_{ss}) \tag{49}$$

Combine the solutions with Equation (**??**), the first-order condition of a^r_{t+1} becomes

$$\lambda^m_t = \beta^m (1 + r) E\left[u'(z^r_{t+1})\right] \tag{50}$$

Combine with the first order conditions of fertility n, investment in the human capital of children i_c, and savings a' at the parent stage with those at the other stages, we can get the equations in Section 5.3.