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Abstract

Aging and an increasing retired population are a global challenge. Previous studies suggest that retirement affects economic behaviors of the retiree and his or her spouse, including consumption, health outcome, and time use. However, little is known about the intergenerational effects of parental retirement on adult children. This paper studies the effects of parental retirement on adult children's labor supply through intergenerational time and monetary transfer. We exploit the mandatory retirement age in China as the cut-off point and apply a regression discontinuity (RD) approach to four waves of the China Family Panel Studies (CFPS) Dataset. Our findings suggest that parental retirement reduces adult children's annual hours of labor supply by 3 to 4 percent. This reduction is especially pronounced for female children. We find that the reduction can be explained by parents' increasing demand for time and care from children due to the significant drop in parents' self-rated health upon retirement. Although both male and female children increased their monetary and time transfers to parents, we find that parents tend to make more transfers to sons compared to daughters. Daughters are also more likely to make transfers to parents after they retire, both in terms of money and in terms of time. We therefore urge policy makers to increase formal eldercare provisions and provide workplace amenities such as flexible working hours, especially for female employees.

Keywords Retirement, Labor Supply, Intergenerational Transfer, Gender Role
JEL Codes J26, J22, D64, D13, J01

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1 Introduction

Aging and increasing retired population are a global challenge. Virtually every country in the world is experiencing growth in both the size and the proportion of older persons in the population. In 2019, there were 703 million persons aged 65 years or over in the global population. This number is projected to double to 1.5 billion in 2050. Globally, the share of the population aged 65 years or over increased from 6 per cent in 1990 to 9 per cent in 2019. This proportion is projected to rise further to 16 per cent in 2050, when it is expected that one in six people worldwide will be aged 65 years or over (UN World Population Ageing 2019)[1]. A concurring problem with aging is retirement. Since a retired person either relies on public programs (such as pension system) or assistance from family members, the rising number of older persons can intensify the pressure on their families, especially in countries where public transfers are relatively low.

Research has found that retirement not only affects the retiree but also the economic behaviors of the spouse, for example income and consumption behavior (Charles, 2004; Battistin et al., 2009), leisure activities (Stancanelli and Soest, 2016), home production (Stancanelli and Soest, 2012), cognitive abilities (Mazzonna and Peracchi, 2012) and health and health behavior (Coe and Lindeboom, 2008; Johnston and Lee, 2009; Coe and Zamarro, 2011; Behncke, 2012; Insler, 2014; Eibich, 2015). Studies on the intergenerational effects of retirement, in particular the effect of parental retirement on adult children's labor supply, remain scarce. Bertrand et al. (2003) examine how the pension transfer paid to parents affects the labor supply of prime-age individuals living with these elderly in extended families in South Africa. They find a sharp drop in the working hours of prime-age individuals in these households when women turn 60 years old or men turn 65, the ages at which they become eligible for pensions. In addition, the oldest son in the household reduces his working hours more than any other prime-age household member. Recent research finds that in Europe parental retirement increases fertility rate and women's retirement leads to an increase in their daughters' employment in countries with low family benefits, while the opposite is true in high family-benefits countries (Eibich and Siedler, 2020; Fenoll, 2020). In the Chinese context, Chen and Zhang (2018) find that maternal retirement decreases female children's childcare time by eight hours per week. At the same time, the retirement of mothers/in-law significantly increases the employment rate of women with children by 12%. There are, however, two major limitations of the existing literature. First of all, it only looks at

[1]https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Report.pdf

the extensive margin of female labor supply, namely, the binary definition of whether the woman is working or not, without looking at the actual hours. It is entirely possible that adult female children's labor participation rate increased but the average hours decreased, which is a net negative effect. Second, the study focuses narrowly on the effect of maternal retirement on female children without examining either the effect of paternal retirement or the heterogeneous effects of parental retirement on female and male children.

Another intriguing question to explore, especially for Asian countries like China where gender role is clearly defined and salient, is whether parental retirement affects male and female children's labor supply differently. Pioneering research by Akerlof and Kranton (2000), for example, suggests that men and women are associated with different behavioral prescriptions, such as "men work in the labor force and women work in the home". Such prescriptions may simultaneously affect hours of market labor supply and the division of tasks within households, such as childcare and eldercare. Budig and England (2001) find that the burden of childcare often falls disproportionally on women. Ettner (1995) uses data from the 1986-1988 panels of the Survey of Income and Program Participation (SIPP) and shows that informal care-giving has a significant negative effect on female market labor supply in the U.S.. In particular, coresidence with a disabled parent has a large and significant negative impact on female labor supply, although most of this effect is due to non-participation in the labor force rather than to a reduction in hours among workers. Ettner argues that the asymmetrical effect of eldercare on male and female can be explained by social norms "making decisions to substitute nonmarket for market labor more difficult for men." The effect of gender identity on female labor supply and home production is particularly relevant in the case of China, where the society is in a transition period in terms of social norms. Although the rate of female labor force participation in China is relatively high, this rate is gradually decreasing: the participation rate for the females was 91% in 1990, 87.6% in 2000, and 83.2% in 2010 (Li et al., 2015). This might indicate that Chinese women are finding it more challenging to balance work and family responsibilities.

This paper studies the effects of parental retirement on adult children's labor supply and explores the mechanism of such effects through the change in intergenerational time and monetary transfers. We use four waves of the China Family Panel Studies (CFPS), which is representative of 95 percent of the Chinese population and provides detailed information on birth year and month, hours worked, retirement status and other demographic information. To identify causal relationship, we apply a regression discontinuity (RD) design to examine the effect of reaching the mandatory retirement age (60 years old for men, 55 years old for women in SOE, 50 years old for women in private enterprises). We find a sizable increase in actual retirement rate at the mandatory age cut-off, indicating high compliance rate to the retirement policy.

We find that there is a drop of 77 to 82 hours per year in adult children's labor supply at parents' mandatory retirement age, which is equivalent to a 3 to 4 percent drop in annual average hours. This effect is statistically significant and robust to the inclusion of self-employed workers who enjoy more flexible working schedule as well as alternative model and time window specifications. We also find a significant increase in the probability of adult children transferring time and money to retired parents. Adult children are 3.8 percent and 4.5 percent more likely to transfer money and time respectively to parents after they retire. We propose two possible explanations. First, due to social convention and the lack of formal eldercare programs in China, adult children are the primary caregivers for their parents and need to shoulder the majority of time and monetary burden. Second, there seems to be an increasing demand for care from parents post retirement since we find a significant drop in parents' self-rated health level after retirement. This is consistent with findings in the literature that parents tend to believe that they are less healthy and require more attention from caregivers when transitioning into retirement life (Müller and Shaikh, 2018; Fitzpatrick and Moore, 2018). We also find that the drop in hours is driven by parents who self-rated as less healthy.

In addition, we find that the decrease in working hours is more salient for daughters than for sons. Controlling for children's own age and year fixed effects, daughters annual hours of labor supply decrease by 123.7 hours from an average of 2,138.67 hours (6 percent), which is sizable and significant at the level of 1 percentage point. In comparison, sons only experienced a statistically insignificant decrease of 49.05 hours. This is consistent with the findings in the gender role literature where daughters are more likely to devote time into care-giving within the household. Likewise, although the probability of parents making time and monetary transfer to children also increased after retirement, we find that daughters are less likely to receive such transfers than sons. Such disparate transfer pattern can be explained by social norm and traditional gender role. Chinese parents favor sons over daughters (Ebenstein, 2010) and sons are considered as the "family name bearer". Therefore, parents are more likely to give money to and do housework for sons. Moreover, the disproportional care provided by daughters can also be explained by gender role. Traditionally men and women are associated with specific behavioral prescriptions as "the bread winners" and "the home makers" respectively. The effect of gender identity on female labor supply and home production is particularly relevant a society is in a transition period in terms of social norms like China. Chinese women are found to be spending twice the time fathers do on childcare, indicating that it has become more challenging for Chinese women to balance work and family responsibilities (Chen and Zhang, 2018). Since it is costly to deviate from social norms or gender identity, such prescriptions reinforce daughters to carry more duty on taking care of and providing help to parents (Budig and England, 2001; Ettner, 1995).

Our paper has three major contributions. First, we add to the aging and retirement literature by examining the spillover effects of retirement. In particular, we study the effects of parental retirement, both paternal and maternal, on both male and female adult children's labor supply. In addition, we further investigate the underlying mechanism behind such changes by examining intergenerational transfers – money and time – both downward (from parents to children) and upward (from children to parents). By doing so, we are able to not only examine the gender difference in terms of the externality of retirement but also identify the gender difference within each channel of such impacts. We provide new evidence on the negative impacts of the drop in parental self-rated health upon retirement on adult children's labor supply, which has not been examined in the past literature. Second, we add to the gender inequality literature by examining the complex interplay among gender identity, care-giving, and female labor supply in China. Using parental retirement as an exogenous shock, we are able to estimate how male and female adult children response differently to the increased needs for eldercare, how male and female adult children give and receive monetary and time support from parents disproportionately, and how such inequalities affect male and female children's hours of market supply differently. Third, our results call for policy reform that addresses the negative effects of parental retirement on adult children, especially on women. An affordable public elderly care system may help reduce the burden of prime age adults, increase overall labor supply and therefore tax base, and boost economic development in the end. In addition, workplace policies designed to help women employees specifically, for example flexible hours, will also help female adult children adjust their schedules, take care of their parents without negatively affecting their job performances.

This paper proceeds in seven sections. In Section 2, we give background on the aging, mandatory retirement and eldercare in China. In Section 3, we describe the data and the sample construction. In Section 4, we conduct the analysis accessing the change in adult children's labor supply due to parental retirement and heterogeneous effects by gender. Section 5 explores the mechanisms. Section 6 provides robustness checks using alternative model specification and alternative time window specification. Section 7 concludes.

2 Aging, Mandatory Retirement and Eldercare in China

China has the largest population and faces the fastest growing aging population (United Nations, 2019). The old-age dependency ratio, defined as the number of people at retirement age per 100 working people, increases from 10 percent in 2000 to 17 percent in 2020. The share of the population over 60 years of age is now projected to rise from 17.4 percent in 2020 to 30 percent in 2040, while the fertility rate will continue to remain low (United Nations, 2019). This is mainly due to decades of falling birth rates and steeply rising life expectancy. At the same time, China has been implementing the mandatory retirement policy since 1978 and is one of the countries with the earliest retirement age. For workers in private enterprises, men and women are supposed to retire at the age of 60 and 50 respectively. In sectors such as public sectors, state-owned enterprises (SOE) and collectively-owned enterprises (COE), the mandatory retirement for men and women are 60 and 55 respectively.

The combination of aging and mandatory retirement placed huge pressure on Chinese families. In China, families have been the main source of financial support and care-giving for the elderly. Nearly 75 percent older adults have children living with them or residing nearby who can provide care (Lei et al., 2015) [2]. Studies suggest that only 3% of the elderly have a commercial pension and 0.2% a private occupational pension issued by a private employer in 2013 (Zhu and Walker, 2018).

Policy makers in China have made several attempts to tackle the many aging and care-giving related issues, including proposing a "three tiers of social services for the aged" – home-based care as the "basis," community-based services as "backing," and institutional care as "support." A series of national policy initiatives over the last decade attempted to develop community-based services. A notable example was the Starlight Program, under which the government invested a total of 13.4 billion yuan (roughly US $2.1 billion) to build urban community-based senior services centers during 2001–04. However, the centers have apparently not served their intended purpose partly because of dwindling financial support from the government, raising questions about the viability of similar initiatives. To date, self-sustaining, community-based long-term care services remain largely nonexistent, except in a few major urban centers like Shanghai (Wu et al., 2005). In addition, policy initiatives to support home or community-based care have been largely limited to urban areas, and even there, the number of beneficiaries is still relatively small. In much of rural China, institutional elder care was rare and limited to state-run institutions exclusively serving childless elderly

[2] About 41% of older adults live with an adult child, and another 34% have an adult child living nearby.

adults, orphans, the mentally ill, and developmentally disabled adults without families in 2000s (Feng et al., 2012).

With insufficient formal care programs, adult children still act as the primary caregiver to retired parents. That is, adult children have no choice but to provide significant time and monetary transfers to retired parents.

3 Data

Our data comes from four waves of the China Family Panel Studies (CFPS), the representative household survey for year 2010, 2012, 2014 and 2016, respectively. The CFPS sample covers 25 provinces/municipalities/autonomous regions, representing 95% of the Chinese population. At the individual level (i.e. each household member), the survey collects information on demographic information including birth year and month, gender, and an urban/rural indicator. It also includes information on individual's smoking and drinking behavior in recent months, self-rated health status, retirement status, marital status, education level, employment status, annual hours worked, job type (waged/agricultural), sector (state-owned/collectively-owned/private), and annual income for both parents and adult children. At the household level, the survey collects information on total assets, family size, and number of kids under age 16.

Sample Construction We construct a child-centric sample where each observation is an adult child for year 2010, 2012, 2014 and 2016. First, we match each adult child to his or her first-retired or first-to-retire parent. For example, if person X's mother retired in 2011 and her father retired in 2013, we will pair X with her mother. This is because the effect of the second retirement within the same household tend to be attenuated by the first shock of retirement. To avoid such bias, we only look at the first retirement that occurred to each adult child. For consistency, only the first-to-retire parent is included on the left hand side of the cut-off. For example, if in 2012, person X's mother is three years away from retirement and her father is two years away from retirement, we will pair X with her father. To simplify our language when referring to one's first-retired or first-to-retire parent in later sections, we term it "parent" for convenience. For adult children who are married, we also include his or her spouse in the sample, pairing the spouse with the same retired parent in the household.

Second, we exclude people who do not report working hours and those who only engage in their own agricultural production. About 72.3 percent of non-agricultural workers report working hours, whereas only 26.7 percent of agricultural workers who do temporary paid job and earn wages report working hours. Third, we focus on the sample of individuals with non-missing working hours and whose parents' ages are within a certain window around the mandatory retirement age. This is because the identification strategy we use – RD design – requires a small window around the cutoff to deliver the local treatment effect of an exogenous shock. Details about the RD design are discussed in section 4. However, there is no statistical or econometric consensus on the choice of window size. The rule of thumb is to select a window size narrow enough to ensure the local-ness of the estimates, but not so narrow that the sample size becomes too small. Here, we choose five years below and above the cut-off so as to balance the sample size and the local-ness of the estimates. We use seven years below and above the cut-off as a robustness check in section 6 and the main results stay valid.

In terms of intergenerational transfers, we observe both monetary and time transfers on the extensive margin. Namely, we observe the occurrence of time and monetary transfers, but not the frequency or amount of such transfers. In the survey, questions such as "Did you give money/care/financial management to parent in the past six months?" and "Did you give monetary support/housework help/financial management to your child [1/2/3/4/...]?" provide us with information on the occurrence of intergenerational transfers. For the latter question for parents, we observe each parent's response for each of his or her own biological child, who is assigned a unique child ID. For upward transfers from adult child to parent, we match each adult child's answer to the child-centric sample using his or her person ID. For downward transfers from parent to each adult child, we match parent's answer to the child-centric sample using the child ID nominated by the first retired parent.

We code answers to the transfer questions as binary variables to indicate the probability of parent providing (receiving) care and money to (from) any specific adult child. For example, if person X answers "yes" to "Did you give money to parent in the past six months?", then his or her "Ever transfer to parent – Money" variable would be coded as one, zero otherwise. Similarly, if a first-retired or first-to-retire parent answers "yes" to "Did you give monetary support to your child [3]?" and person X's ID matches that of child [3], then his or her "Ever receive from parent – Money" variable would be coded as one, zero otherwise.

Summary Statistics Table 1 describes the key features of our constructed sample. 41 percent of adult children are female and the average age is 28.93 years old. 56.3 percent of the adult children reside in urban areas. On average they have more than 10 years of education. Average net asset holding is about 321,000 RMB, which includes house, car, and financial assets minus debts. 61 percent of the adult children in our sample have kids. The majority of the kids are between 6 and 16 years old.

Parental age is re-coded so that 60 is set as the "reference cut-off" for both mother and father. For example, if a mother is 53 years old and works for a private enterprise (meaning that her mandatory retirement age is 50), we re-code her age as 63 using the formula 53+(60-50)=63. Similarly, if a mother is 67 years old and worked for a SOE (meaning that her mandatory retirement age is 55), we re-code her age as 72 using the formula 67+(60-55)=72. The average re-coded parental age is 58.2 years old, which is just around the 60-year-old "reference cut-off". About 30 percent of adult children in our sample have at least one retired parent. On average, they work for 2,583.57 hours per year, or around 49 hours per week.

Table 1 panel B shows the average probabilities of upward and downward transfers. Interestingly, adult children are more likely to transfer money to parents (3.9 percent) than providing care or housework (2.5 and 2.6 percent). On the contrary, parents are more likely to do housework for adult children (4.7 percent) than providing financial support (1.8 percent).

4 Assessing the Change in Adult Children's Labor Supply Due to Parental Retirement

To estimate the change in adult children's labor supply due to parental retirement, we compare the annual hours of labor supply of adult children whose parents' ages are right above the mandatory retirement age to those right below the cut-off. Parental retirement decision could be affected by unobserved factors that could simultaneously affect the adult children's labor supply, for example, valuation for family time, work ethics, etc. Thus, to reach a causal inference, we use a Regression Discountinuity (RD) design to eliminate the potential endogeneity of parental retirement decisions.

The RD design has been used in previous literature studying the causal effect of reaching retirement age on health insurance coverage, mortality, and spousal health outcome (Card et al., 2008; Fitzpatrick and Moore, 2018; Shigeoka, 2014; Lee and Lemieux, 2010). The RD approach aims to compare the average outcomes just below and just above the cut-off. As discussed in Section 3, there is no statistical or econometric consensus on the choice of window range. Here, we choose five years as the window to balance both the sample size

Table 1: Summary Statistics: Adult Children

	Mean	SD	N
Panel A			
Female	0.411	0.49	7565
Age	28.931	5.11	7565
Urban Area	0.563	0.50	7245
Married	0.696	0.46	7565
Years of schooling	10.539	3.88	7204
Net asset (thousand RMB)	321.36	1176.42	7115
Have kids	0.612	0.49	7565
N. kids	1.486	0.80	4626
N. kids under age 1	0.095	0.30	4626
N. kids age 1-2	0.317	0.51	4626
N. kids age 3-5	0.453	0.60	4626
N. kids age 6-16	0.621	0.75	4626
Parent Age (recode)	58.207	3.53	7565
Engage in Non-agricultural work	0.977	0.15	6525
Parent Retired(a)	0.302	0.46	5,618
Parent Retired(b)	0.257	0.44	15,498
Panel B			
Hours			
Annual hours worked	2583.57	1203.76	7565
Annual hours worked plus self employed	2415.86	1120.003	7799
Transfers			
Whether give [..] in the past 6 months			
Money to parent	0.039	0.19	4773
Housework to parent	0.025	0.16	4773
Care to parent	0.026	0.16	4773
Financial management to parent	0.003	0.06	4773
Money to support children	0.018	0.13	4773
Housework children	0.047	0.21	4773
Financial management to children	0.005	0.07	4773

Note: One unit of observation is one adult child. This table reports the characteristics of adult children with non-missing working hours and whose parents' re-coded ages are within the ± 5 years window. Parent Retired (a) is the fraction of adult with non-missing working hours. Parent Retired(b) is the fraction of adults with or without missing working hours.

and the localness of the estimates[3].

In addition, "age RD design" involves a distinct feature from the standard RD design. Since all individuals will eventually pass the retirement age, assignment to treatment is inevitable. Hence, individuals who anticipate the parental retirement may adjust their behavior ahead of time (Lee and Lemieux, 2010). If adult children anticipate potential change in lifestyle, for example a reduction in overall family income, they would increase their labor supply before the parental retirement, which would lead to an upward bias in our estimate

[3]We also use seven year as robustness checks and the main results stay similar.

of the effects of parental retirement on adult children's labor supply. On the contrary, adult children may predict that their job performance will be negatively affected by parental retirement anyways and start to work fewer hours before the actual retirement, which would lead to a downward bias of our estimate. To test if our results are in fact biased by such anticipation effects, we run a "donut hole" RD as a robustness check in Section 6, where we exclude observations within one year above or below the threshold (Shigeoka, 2014; Mazumder and Miller, 2016).

The mandatory age provides an exogenous shock to retirement decisions. Figure 1 shows that retirement rate has a sizable jump right around the cut-off. There is a clear increase in the retirement rate for both male and female, suggesting that people are indeed complying to the mandatory retirement policy. Thus, our RD estimates can be interpreted as valid intent-to-treatment effects of parental retirement on adult children's labor supply, as long as other observed factors affecting parental retirement do not change discontinuously right around the cut-off. We test this condition with the validity check in Section 4.2.

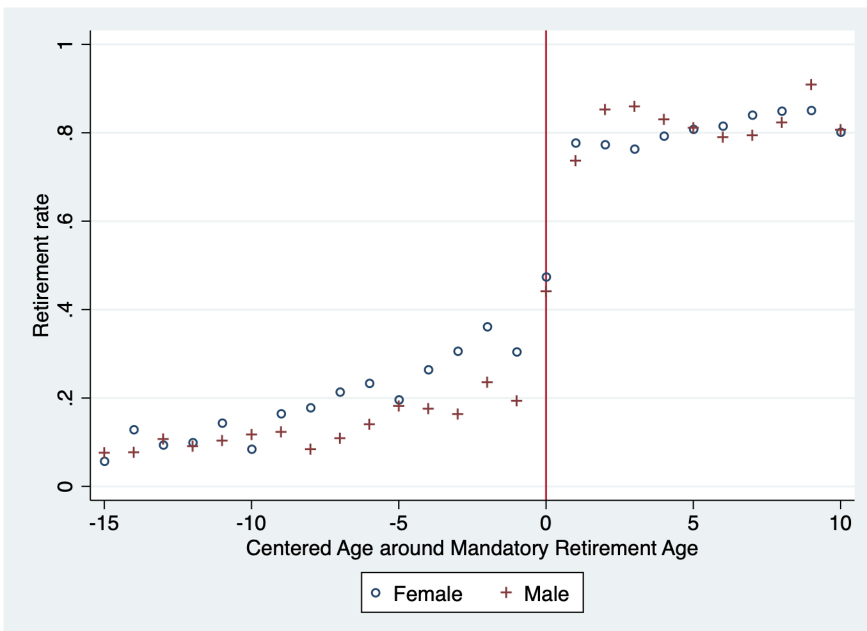


Figure 1: Fraction of Parental Retirement and Parent Age Relative to the Mandatory Cutoff
Note: This figure shows the compliance rate of parents. The x-axis is parental age relative to mandatory retirement age (The mandatory retirement age for is 50 for general female workers and 55 for females who work in public sectors, state-owned enterprises and collectively-owned enterprises; 60 for male workers). The y-axis is the fraction of people whose reported employment status is "retired". The blue circles represent female while the red dots represent male.

4.1 Graphical Result

Figure 2 shows the scatter plots of adult children's annual working hours overlaid with lines from local linear regressions in a window of ± 5 years around the mandatory retirement cut-off. Panel (a) clearly reveals a significant drop in adult children's average annual hours as soon parents reach the mandatory retirement age.

It is possible that people develop different working schedules as they age, and that the reported hours could be systematically different across years. To remove the effects of adult childrens' own age and year fixed effects, we also plot the residual annual hours predicted from the following model (model 1):

$$H_{it} = \alpha_1 Age_{it} + \eta_t + \nu_i \tag{1}$$

where H_{it} is adult i's annual hours of labor supply, Age_{it} is adult i's own age, and η_t is year fixed effects. Residual $\hat{H}_{it}$ from model 1 is the residual annual hours which partial out any other potential effects and focus on the impact of parental retirement alone. Figure 2 panels (b) and (c) illustrate the residual annual hours against years from or to the parental retirement. We fit a linear model in Panel (b) and use a non-parametric triangular kernel approach in Panel (c).

After removing the effect of own age and year fixed effects as suggested in Panel (b) and Panel (c), the drop in annual residual hours around the cut-off becomes even more pronounced. Our graphical results therefore clearly shows a significant discontinuity in adult children's working hours at the threshold.

4.2 Regression Results

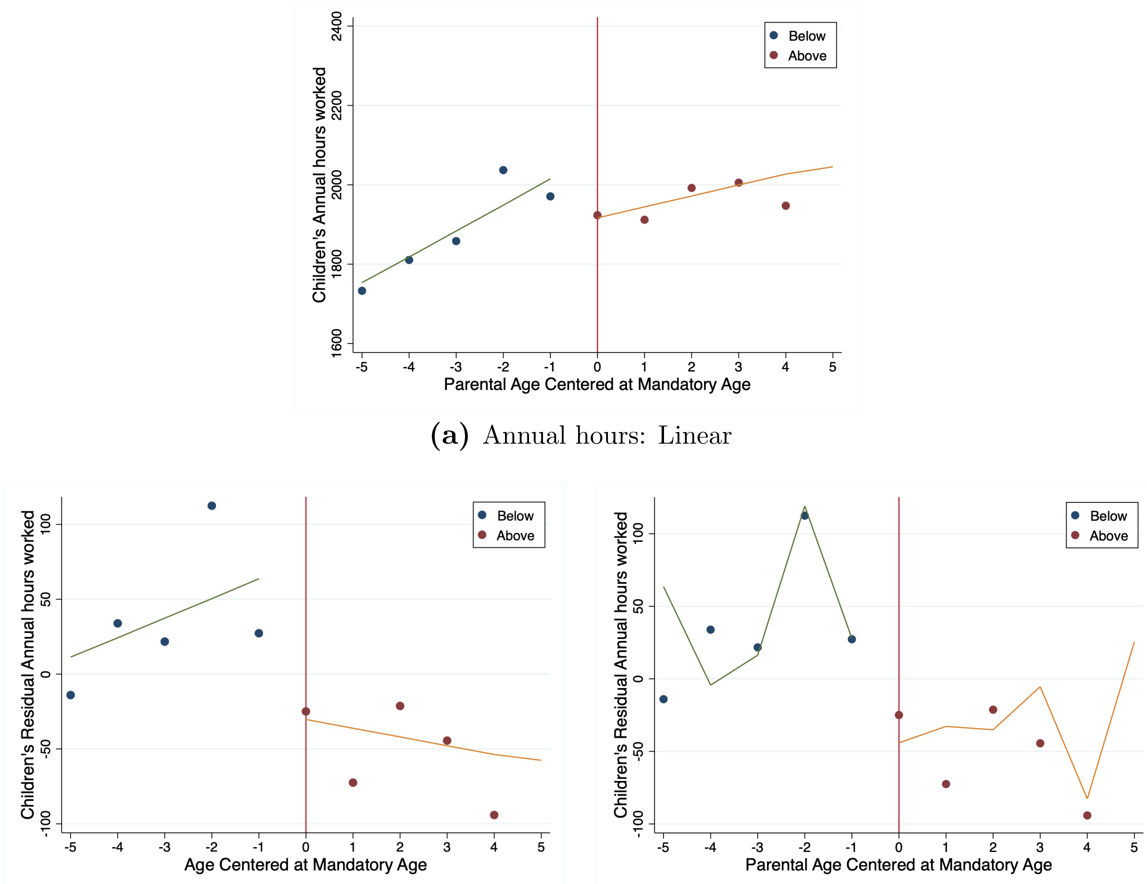
Following similar study designs in the literature (Lee and Lemieux, 2010; Card et al., 2008; Shigeoka, 2014), we employ a Regression Discontinuity (RD) approach using the mandatory retirement age as the cut-off. Our main regression equation is as follows:

$$H_{it} = \beta_1 Post_{it} + \beta_2 Running_{it} + \beta_3 Post_{it} \times Running_{it} + Age_{it} + \eta_t + \varepsilon_i \tag{2}$$

where

$$Post_{it} = \mathbf{1}\{Running_{it} \geq 0\}$$

$$Running_{it} = \max\{R_{it}^{dad}, R_{it}^{mom}\}$$



(a) Annual hours: Linear

(b) Residual hours: Linear

(c) Residual hours: Local polynomial

Figure 2: Adult Child Annual hours and Parental Mandatory Retirement

Note: The x-axis is the re-coded parental, with zero corresponding to the mandatory retirement cut-off. In figure (a), the y-axis is adult children's annual hours of labor supply. Dots are means in 1-year bins. The red and blue lines are fitted from two separate linear regressions, one using data points above the cut-off and the other using data points below the cut-off. In figure (b) and (c), the y-axis is the residual annual hours of labor supply predicted from regression $H_{it} = \alpha_1 Age_{it} + \eta_t + \nu_i$. In (b), dots are means in 1-year bins.The red and blue lines are fitted from two separate linear regressions, one using data points above the cut-off and the other using data points below the cut-off. In (c) dots are means in 1-year bins. The red and blue lines are fitted from two separate local linear regressions using a triangular kernel with a 0.74-year bandwidth, one using data points above the cut-off and the other using data points below the cut-off.

$$R_{it}^g = Age_{pt}^g - C^g, g = \{dad, mom\}$$

where subscripts i and p denote adult child and parent respectively. Model 2 is child-centric, where the dependent variable and regressors are defined from the perspective of each adult child. H_{it} is the outcome variable – adult child i's annual hours of labor supply in year t. C is the mandatory retirement age and varies by gender and occupation, which is individual- and time-invariant. Age_{pt}^g is the adult child i's father's age and mother's age, and R^g_{it} is the distance between i's mother or father's age and the mandatory retirement age. Our running variable, $Running_{it}$, picks the greater of R^{dad}_{it} and R^{mom}_{it} – namely, only the first-retired or first-to-retire parent's information will be included in our regression. $Post_{it}$ is a dummy variable that takes value one if the individual i's first-retired or first-to-retire parent has reached the cut-off C in year t. We include the interaction term of $Post$ and the running variable $Running_{it}$ to allow for different slopes below and above the cut-off. Age_{it} is adult child i's own age in year t. To capture differential economic condition and measurement discrepancy across survey years, we include year fixed effects η_t. ε_i is an i.i.d distributed error term. The parameter of interest is β_1, which captures the change in adult child's annual hours of labor supply due to parental retirement.

Validity Checks One key assumption of the RD design is that other pre-determined characteristics of the parents are smooth at the cut-off. Pre-determined variables include parents' marital status, gender, years of education, number of kids, whether they are frequent smokers or drinkers, and whether parents are covered by the pension system. Figure A1 in the Appendix shows the scatter plots of the above variables, overlaid with lines from local linear regressions using data within our ± 5 years window. The graphs show no visible discontinuities at the cut-off, indicating that local assignment around the cut-off is random. Table A2 in the Appendix shows the corresponding statistical test results. We find no significant changes at the cut-off, which confirms that the pre-determined covariates are smooth[4]. Overall, the RD validity checks support our empirical strategy and provide no evidence of violations of the key identifying assumptions.

Results Table 2 reports the baseline results from model 2. Column 1 suggests that on average parents are significantly more likely to retire once they pass the mandatory age. This correlation corresponds to the clear jump in the retirement rate in Figure 3. Columns 2 and 3 suggest that adult children's hours decrease by about 77 to 82 hours in a year, which is equivalent to a 3 to 4 percent drop from the annual average. The estimates are precise and significant at the level of one percentage point. In Column 2, we measure the dependent variable by considering the annual working hours for people who work in hired jobs. This includes both waged workers in urban areas and seasonal hired workers in rural areas. To make our analysis more general, we include self-employed adult children in our sample and

[4]We also check children's pre-determined characteristics including marital status, gender, years of education, number of kids. The results are shown in Figure A2 and Table A3 in the Appendix. Again we find no significant discontinuities at the cut-off.

Table 2: Baseline: Adult Children Hours Worked Around Parental Retirement

	(1)	(2)	(3)
		Hours	
Dep. var.	Parent Retired	Hired jobs	Hired plus Self-employed
Post	0.17***	-81.50***	-77.22***
	(0.013)	(27.63)	(27.37)
Running	0.01***	-2.86	-2.48
	(0.002)	(10.82)	(11.15)
Running x Post	0.038***	14.86	13.43
	(0.004)	(17.67)	(16.05)
Age_c		12.47***	17.05***
		(2.26)	(2.443)
Constant	0.001	2,041***	1,910***
	(0.008)	(75.90)	(84.81)
R-squared	0.206	0.103	0.068
Year FE	Yes	Yes	Yes
windows	5	5	5
Observations	15,498	7,573	7,799

Note: One unit of observation is a parent in column 1 and an adult child in column 2 and 3. "Parent Retired" is a dummy variable that takes value one if the parent's employment status is "retired" and zero otherwise. The dependent variable in Column 2 is the annual hours for hired jobs. The dependent variable in Column 3 is the annual hours of hired job plus self-employment hours. "Post" is a dummy variable that takes value one if an adult's first-to-retire parent has reached the mandatory retirement age and zero otherwise. "Running" is the first-to-retire parent's age minus the his or her corresponding mandatory retirement age. "Age_{it}" is the age of the adult child i's own age in year t. Year fixed effects are included in all columns. Standard errors are reported in parentheses and clustered by adult child birth year. *** p<0.01, ** p<0.05, * p<0.1.

report our regression results in Column 3. It's interesting to note that column 3 shows a smaller drop in hours of labor supply, meaning that self-employed adults experience a less significant negative effect. It is likely that the self-employed have more flexibility in their schedules so they can more easily accommodate the need to take care of parents without reducing total hours.

4.3 Heterogeneous Effects on Male and Female Children

In addition to the overall effect of parental retirement on adult children's labor supply, we are also interested in exploring if male children (sons and male spouses) and female children (daughters and female spouses) are affected differently. For this purpose, We re-run the baseline analysis in Model 2 for men and women separately.

Table 3 reports our gender-specific results. In columns 1 and 2, we include adult children who reported hours in hired jobs, while in columns 3 and 4 we also include self-employed individuals. Column 1 shows that after controlling for own age and year fixed effects, women's annual hours decreases by 123.7 hours from an average of 2,138.67 hours, which is equivalent to a 6 percent drop ($p < 0.01$). Column 2, however, shows a statistically insignificant change in men's annual hours. When we include self-employed individuals in columns 3 and 4, the sample sizes for both men and women slightly increase. As shown in column 3, women's hours decreases by around 89 hours, which is equivalent to 4 percent of the annual average. Men's hours as shown in Column 4, however, has not change significantly.

It is surprising that there is a significant difference in women and men's labor supply responses to parental retirement. However, this finding is consistent with other related findings in the the social norm and gender role literature where women are expected to perform more family duties compared to men. Traditionally men and women are associated with specific behavioral prescriptions as "the bread winners" and "the home makers" respectively (Budig and England, 2001; Ettner, 1995). It is possible that women suffers the burden due to the duty reinforced by social norms or gender identity. If this is the case, we expect to see differential transfer patterns between daughters and sons.

In sum, we find that overall there is a 3 to 4 percent drop in adult children's annual hours of labor supply when their parents retire. This reduction is more salient for daughters or female spouses than for sons or male spouses. In the next section, we explore possible explanations for the drop and for the gender-specific effects by studying the time and monetary transfer patterns between parents and children.

5 Mechanism of the Change in Adult Children's Labor Supply

In this section, we explore the underlying mechanism that helps explain the changes in adult children's labor supply due to parental retirement. We examine changes in monetary and time transfers between adult children and their parents, which could be caused by changes in living arrangement and changes in parental health.

5.1 Time and Money Transfers

Due to retirement, parents would experience a drop in income and consequently consumption. Conforming to social norm, children would have the incentive to transfer money to

Table 3: Adult Children Hours Worked Around Parental Retirement: By Gender

	(1)	(2)	(3)	(4)
	Hours in hired jobs		Hours hired plus SE	
Dep. var.	Women	Men	Women	Men
Post	-123.70**	-49.05	-88.92*	-62.31
	(50.02)	(45.28)	(50.09)	(49.66)
Running	5.45	-9.61	2.93	-5.77
	(16.56)	(10.66)	(17.35)	(11.36)
Running x Post	24.58	12.54	22.45	10.02
	(26.35)	(17.47)	(28.12)	(16.00)
Age_c	7.57*	11.85***	11.67***	15.84***
	(4.13)	(2.87)	(4.07)	(3.01)
Constant	2,139***	2,079***	2,009***	1,973***
	(112.10)	(105.50)	(112.20)	(112.00)
R-squared	0.110	0.103	0.069	0.072
Year FE	Yes	Yes	Yes	Yes
windows	5	5	5	5
Observations	3,110	4,455	3,197	4,669

Note: One unit of observation is an adult child. The dependent variables in Columns 1 and 3 are the annual hours of labor supply in hired jobs. The dependent variables in Columns 2 and 4 are the annual hours in hired job plus the self-employment hours. "Post" is a dummy variable that takes value one if an adult's first-to-retire parent has reached the mandatory retirement age and zero otherwise. "Running" is the first-to-retire parent's age minus the his or her corresponding mandatory retirement age. "Age_{it}" is the age of the adult child i's own age in year t. Year fixed effects are included in all columns. Standard errors are reported in parentheses and clustered by adult child birth year. *** p<0.01, ** p<0.05, * p<0.1.

support their parents(Bertrand et al., 2003). At the same time, due to the lack of formal eldercare system, adult children have to act as primary caregivers and parents may prefer to compensate children with money for their provision of care (Antonucci, 1990; Bernheim et al., 1985; Brandt and Deindl, 2013).

With an increase in parents' leisure time, we may expect that parents would help children more with housework, which would lead to an increase children's labor supply. However, papers in the past have shown that parents experience physical and mental decline when transitioning to retirement (Müller and Shaikh, 2018; Fitzpatrick and Moore, 2018). Therefore, it is possible that parents would need more support from adult children once they retire, especially at the beginning of this transition. To explore the changes in intergenerational transfer patterns, We replace the dependent variable in Model 2 with various transfer measures and estimate the following linear probability model:

$$Y_{it} = \gamma_1 Post_{it} + \gamma_2 Running_{it} + \gamma_3 Post_{it} \times Running_{it} + Age_{it} + \tilde{\eta}_t + \tilde{\varepsilon}_c \quad (3)$$

where $Y_{it} = \{CareC_{it}, CareP_{it}\}$ is the set of transfer variables. To be consistent with the baseline Model 2, Model 3 is also specified as child-centric, where the dependent variables and regressors are defined from the perspective of each adult child. Dependent variable $CareC_{it}$ is a dummy variable that takes value one if adult child i provided care or monetary transfer to his or her parent in the past six months in year t, and zero otherwise. Similarly, $CareP_{it}$ is a dummy variable that takes value one if adult child i received time or monetary transfer from parents in the past six months in year t, and zero otherwise. Other variables are the same as described in Model 2. Here, to be consistent, we adopt the linear specification without further parametric assumption on the error term as in Model 2. Given that the dependent variables are binary, we conduct robustenss checks using Probit model in Section 6.

γ_1 is the parameter of interest since it captures the change in the probability of upward and downward transfers due to parental retirement. Note that we can only observe transfers between parents and their biological children. So a caveat in interpreting our results is that our regression sample only considers biological daughters and sons while excluding spouses[5].

Table 4 reports our regression results from Model 3. Column 1 and 2 suggest that adult children are 3.8 percent and 4.5 percent more likely to transfer money to and do housework for parents after their parents retire. These findings are consistent with the social norm in China where adult children are expected to take care of their parents. Column 3 and 4 report changes in the likelihood of transfers from parents to adult children. Parents are 3.9 and 5.6 percent more likely to transfer money to and or do housework for their children after retirement. There are two possible explanations for such increases in downward transfer. On the one hand, since adult children spend more time taking care of parents after the parents retire, it is possible that parents compensate their children by giving small money in exchange (Antonucci, 1990; Bernheim et al., 1985; Brandt and Deindl, 2013). On the other hand, parents might use their own money when they do housework for their children. For example, anecdotal evidence suggests that parents sometimes cover their children's daily expenses partially or pay for grocery shopping and transportation. One may point out that that the magnitudes of coefficients for downward transfers are greater than those for upward transfers. However, one should be cautious when making such comparisons, because we only observe the extensive margin instead of the amount of transfers.

Next, we investigate if male and female children experience different changes in terms

[5]It is possible that parents attribute the efforts of children's spouses to their own children, which might lead to an upward or downward bias.

Table 4: Transfer: Adult Child Give or Receive Help From Parents

	(1)	(2)	(3)	(4)
	Ever transfer to parent		Ever receive from parents	
Dep. var.	Money	Housework	Money	Housework
Post	0.038**	0.045***	0.039***	0.056***
	(0.018)	(0.014)	(0.013)	(0.018)
Running	-0.003	0.002	0.002	-0.005
	(0.003)	(0.003)	(0.004)	(0.003)
Running x Post	0.021***	-0.004	-0.004	0.023***
	(0.005)	(0.006)	(0.005)	(0.007)
Age_c	0.009***	0.002	-0.008***	0.013***
	(0.001)	(0.001)	(0.002)	(0.001)
Constant	-0.241***	-0.018	0.240***	-0.290***
	(0.036)	(0.031)	(0.065)	(0.040)
R-squared	0.204	0.210	0.207	0.316
Year FE	Yes	Yes	Yes	Yes
windows	5	5	5	5
Observations	4,773	4,773	4,773	4,773

Note: One unit of observation is an adult child. The dependent variables in column 1 and 2 are dummy variables that take value one if the adult child transferred money to or did housework for the parent in the past six months and zero otherwise. The dependent variables in column 3 and 4 are dummy variables that take value one if the adult child received money or housework help from the parent in the past six months and zero otherwise. "Post" is a dummy variable that takes value one if an adult's parent has reached the mandatory retirement age and zero otherwise. "Running" is the parent's age minus the his or her corresponding mandatory retirement age. "Age_{it}" is the age of the adult child i's own age in year t. Year fixed effects are included in all columns. Standard errors are reported in parentheses and clustered by adult child birth year. *** p<0.01, ** p<0.05, * p<0.1.

of intergenerational transfer after parental retirement. Namely, we re-run Model 3 for male children and female children separately and report our results in Table 5. Columns 1 to 4 correspond to the time and monetary transfers to parents (upward transfers), whereas Columns 5 to 8 correspond to the time and monetary from parents to adult children (downward transfers). Interestingly, we observe very different patterns by gender. In columns 1, we see that daughters are 4.4 percent more likely to transfer money to parents, whereas column 2 suggests that sons are not statistically significantly more likely to provide financial supports to parents. However, in columns 5 and 6, we observe that the probability of sons receiving monetary transfer from parents after parental retirement increased significantly, whereas for daughters this is not the case. The same pattern holds true for time transfers. Daughters are 6.7 percent more likely to do housework for parents after their parents retire, while sons' increase in time transfer is almost statistically insignificant and half in size in terms of magnitude. Meanwhile, sons are 8.4 percent more likely to receive help from parents

Table 5: Adult Children Transfer: By Gender

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Ever transfer to parent				Ever receive from parents			
	Money		Housework		Money		Housework	
Dep. var.	Daughter	Son	Daughter	Son	Daughter	Son	Daughter	Son
Post	0.044*	0.035	0.067***	0.035*	0.024	0.047***	0.002	0.084***
	(0.025)	(0.022)	(0.024)	(0.018)	(0.030)	(0.015)	(0.022)	(0.021)
Running	-0.012*	0.001	0.001	0.003	0.003	0.002	0.001	-0.009**
	(0.006)	(0.004)	(0.004)	(0.003)	(0.008)	(0.003)	(0.006)	(0.004)
Running x Post	0.020**	0.021***	-0.008	-0.002	-0.003	-0.005	0.014	0.027***
	(0.008)	(0.006)	(0.012)	(0.005)	(0.011)	(0.005)	(0.011)	(0.008)
Age_c	0.007***	0.010***	-0.003	0.004***	-0.014***	-0.006***	0.008***	0.015***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.003)	(0.002)	(0.002)	(0.002)
Constant	-0.184***	-0.265***	0.091*	-0.0734*	0.362***	0.192***	-0.141***	-0.357***
	(0.057)	(0.038)	(0.049)	(0.036)	(0.087)	(0.055)	(0.043)	(0.047)
R-squared	0.177	0.226	0.217	0.206	0.216	0.210	0.217	0.388
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
windows	5	5	5	5	5	5	5	5
Observations	1,631	3,131	1,631	3,131	1,631	3,131	1,631	3,131

Note: One unit of observation is an adult child. The dependent variables in column 1 (2) and 3 (4) are dummy variables that take value one if the daughter (son) transferred money to, or did housework for the parent in the past six months, zero otherwise. The dependent variables in column 5 (6) and 7 (8) are dummy variables and take value one if the daughter (son) received money, or received housework help from the parent in the past six months, zero otherwise. "Post" is a dummy variable that takes value one if an adult's parent has reached the mandatory retirement age and zero otherwise. "Running" is the parent's age minus the his or her corresponding mandatory retirement age. "Age_{it}" is the age of the adult child i's own age in year t. Year fixed effects are included in all columns. Standard errors are reported in parentheses and clustered by adult child birth year. *** p<0.01, ** p<0.05, * p<0.1.

while daughters are not.

The distinctive transfer patterns between daughters and sons can be explained by the theory of social norm and gender role, as mentioned in Section 1. Regarding social norm, it is a cultural tradition that Chinese parents favor sons over daughters (Li and Wu, 2011; Zheng, 2015). Sons are considered as the "family name bearer". Therefore, parents are more likely to provide both time and monetary transfers to sons. The disproportional upward transfer from daughters can be explained by the theory of gender role. Akerlof and Kranton (2000) for example, suggests that the division of tasks within households is self-sustained through gender norms and identity. The traditional role of Chinese women as homemakers, therefore, can be sustained into the modern era. As an empirical evidence, Chen and Zhang (2018) find that Chinese women devote significantly more hours into housework than men, especially in care-giving. Therefore, the burden of care naturally falls on the shoulders of women as parents retire, resulting in the discrepancies by gender both in terms of labor reply responses and changes in intergenerational transfer patterns.

In the next two subsections, we explore the explanations for the changes in intergenerational transfer upon parental retirement and the disparate transfer patterns by gender.

5.2 Changes in Living Arrangement

One plausible cause of the increase in upward transfers and consequently the decrease in adult children's labor supply could be the changes in living arrangement after parental retirement. It is possible that parents choose to live with their children after they retire and such change could lead to changes in children's time allocation (Bertrand et al., 2003).

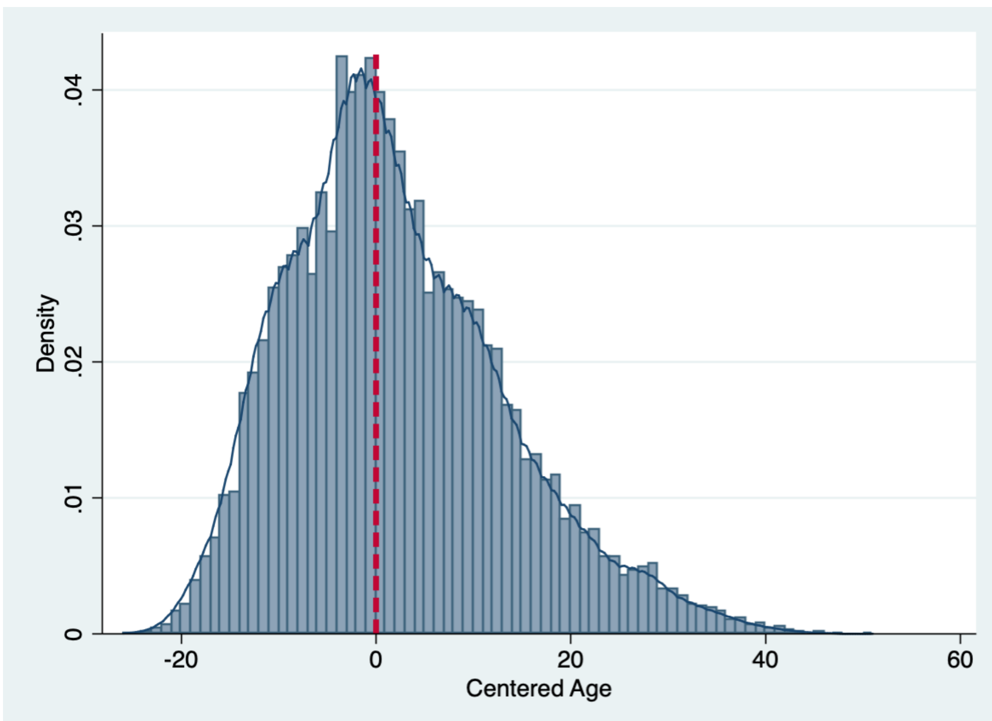


Figure 3: Parental Age Density Distribution Around the Mandatory Cut-off
Note: This figure shows the age distribution around the mandatory retirement cut-off for individuals' parent without limiting to the ±5 windows. The x-axis is parental age relative to mandatory retirement age.

We do not find evidence for changes in living arrangement associated with parental retirement. Figure 3 shows the age distribution of parents around the mandatory retirement cut-off. It suggests that living arrangement does not suddenly change around the cut-off. If parents do not live with their children before they retire and move in with their children after retirement, we would expect to see fewer observations on the left of the cutoff and more on the right, as the first wave of the sample selection only covered parents that live with their children. Our plot, however, shows that the density is rather smooth around the cut-off. Thus, the changes in adult children's labor supply and intergenerational transfer patterns are not likely to be caused by living arrangement changes.

5.3 Changes in Parental Health

To understand why children increase their upward transfers after parental retirement, we examine the changes in parents' lives that might lead to an increased demand for money or care. One key aspect is parental health. We use the the following model to detect significant changes in parents' self-rated health:

$$ParentalHealth_{pt} = \lambda_1 Post_{pt} + \lambda_2 Running_{pt} + \lambda_3 Post_{pt} \times Running_{pt} + X_{pt} + \tilde{\eta}_t + \tilde{\nu}_c \quad (4)$$

where $ParentalHealth_{pt}$ includes 3 sets of outcome variables for a parent. The first set includes binary indicators for each of the five levels of smoking intensity in the past month: (1) never, (2) seldom, (3) frequent, (4) more frequent and (5) heavily smoke. The second set is a dummy variable that takes value one if the parent drank more than 3 times in the past week, and zero otherwise. The third set includes binary indicators for each of the five levels of parental self-rated health: (1) very healthy, (2) moderately healthy, (3) neutral, (4) less healthy and (5) very unhealthy. X_{pt} is parents' smoking and drinking behaviors, which are included here as control variables. The other regressors are the same as in model 2.

Columns 8 to 13 in Table A2 suggest no clear increase in parents' risky health behaviors in terms of smoking and alcohol use. We therefore turn to look at changes in parents' subjective health ratings, which are reported in Table 6. Table 6 columns 1 to 5 report the changes in the likelihood of considering oneself as very healthy to very unhealthy. Column 1 suggests that people are less likely to positively rate themselves as healthy after retirement, after controlling for their drinking and smoking behaviors. The 4.3 percent drop in feeling very healthy (rate as 1) is statistically significant at one percent level. Meanwhile, parents are 4.4 percent more likely to consider themselves as very unhealthy. Thus finding confirms our hypothesis that parents self-rated health are negatively impacted by retirement, which increases their demand for attention and help from adult children.

Table 7 reports the change in hours by parental self-rated health. If a parent reports as "Neutral", "Less Healthy" or "Very Unhealthy", he or she is considered as "unhealthy",

Table 6: Parental Self-rated Health and Retirement

Dep. var.: Healthy	(1) Very	(2) Modest	(3) Neutral	(4) Less	(5) Unhealthy
Post	-0.0430**	-0.00209	0.00132	0.0214	0.0437**
	(0.0209)	(0.0183)	(0.0161)	(0.0208)	(0.0192)
Running	0.004	0.001	0.001	-0.004	-0.006
	(0.005)	(0.005)	(0.004)	(0.005)	(0.006)
Running x Post	0.009	-0.004	3.91e-06	-0.007	-0.005
	(0.007)	(0.006)	(0.005)	(0.007)	(0.008)
Smoke in recent 1 mon	0.0214	-0.0260	0.0585***	-0.00103	-0.0540***
	(0.0139)	(0.0160)	(0.0160)	(0.0148)	(0.0171)
Drink more than 3 times a week	-0.007	-0.014	0.003	0.035**	0.017
	(0.015)	(0.012)	(0.009)	(0.014)	(0.018)
Constant	0.381***	0.453***	0.0639***	0.0761***	0.299***
	(0.020)	(0.020)	(0.015)	(0.017)	(0.023)
R-squared	0.288	0.130	0.190	0.038	0.100
Year FE	yes	yes	yes	yes	yes
windows	5	5	5	5	5
Observations	6,073	6,073	6,073	6,073	6,073

Note: One unit of observation is a parent. The dependent variables in column 1-5 are dummy variables and take value one if one rates himself/herself as "Very Healthy", "Moderately Healthy", "Neutral", "Less Healthy" and "Very Unhealthy" respectively, and zero otherwise. "Post" is a dummy variable that takes value one if an adult's parent has reached the mandatory retirement age and zero otherwise. "Running" is the parent's age minus the his or her corresponding mandatory retirement age. "Smoke in recent 1 mon" and "Drink more than 3 times a week" are parents' risky healthy behaviors that are included here as control variables. Year fixed effects are included in all columns. Standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

otherwise "healthy". Columns 1 and 3 show a large and significant drop in adult children's labor supply due to the poor self-rated health. If we look at people working in hired jobs only, column 1 suggests that the average hours go down by 205.60 hours, which is 2.25 times the effect on people with healthy parents, 91 hours in column 2. At the same time, column 2 suggests that the effect on people with healthy parents is not statistically significant. This finding is also robust when we include self-employed people in columns 3 and 4. This comparison of effects by parental self-rated health suggests that the overall negative impact is driven by self-rated unhealthy parents, who requires more attention from adult children.

Table 7: Adult Children Hours Worked By Parental Self-rated Health

	(1)	(2)	(3)	(4)
	Hired jobs		Hired plus Self-employed	
Dep. var.: Hours	Unhealthy	Healthy	Unealthy	Healthy
Post	-205.6**	-91.05	-130.5*	-47.40
	(83.61)	(83.88)	(74.26)	(60.34)
Running	32.21*	20.25	0.834	14.35
	(16.20)	(21.76)	(18.94)	(21.81)
Running x Post	-32.85	-40.48	31.38	-30.34
	(24.28)	(25.27)	(29.57)	(39.83)
Age_c	32.74***	53.54***	6.514	10.80**
	(7.276)	(6.866)	(4.356)	(4.317)
R-squared	0.169	0.133	0.159	0.102
windows	5	5	5	5
Observations	2,468	3,849	1,707	2,281

Note: One unit of observation is an adult child. The dependent variable in Columns 1 and 2 is the annual hours for hired jobs. The dependent variable in Columns 3 and 4 is the annual hours of hired job plus self-employment hours. "Unhealthy" takes value one if the parent's self-rated health is "Neutral", "Less Healthy" or "Very Unhealthy". "Healthy" takes value one if the parent's self-rated health is "Very Healthy" or "Moderately Healthy". "Post" is a dummy variable that takes value one if an adult's first-to-retire parent has reached the mandatory retirement age and zero otherwise. "Running" is the first-to-retire parent's age minus the his or her corresponding mandatory retirement age. "Age_{it}" is the age of the adult child i's own age in year t. Year fixed effects are included in all columns. Standard errors are reported in parentheses and clustered by adult child birth year. *** p<0.01, ** p<0.05, * p<0.1.

6 Robustness Checks

We perform three robustness checks for our baseline estimates from the following perspectives. First, we check if our estimates of the reduction in adult children's labor supply are affected by the anticipation effects described in Section 4 by performing a set of "donut-hole" RD regressions. Second, we check if our results are driven by parents who retire early because of health issues. Third, we specify an alternative time window (± 7 years) with respect to the mandatory retirement cutoff in Section 6.3 to check if the significant reduction in labor supply still remains. Lastly, given that the dependent variables for transfer and parental self-rated health are binary variables, we replace the linear probability model with a Probit model and check if the estimated effects are sensitive to model specifications in Section 6.4.

6.1 Donut-Hole Design

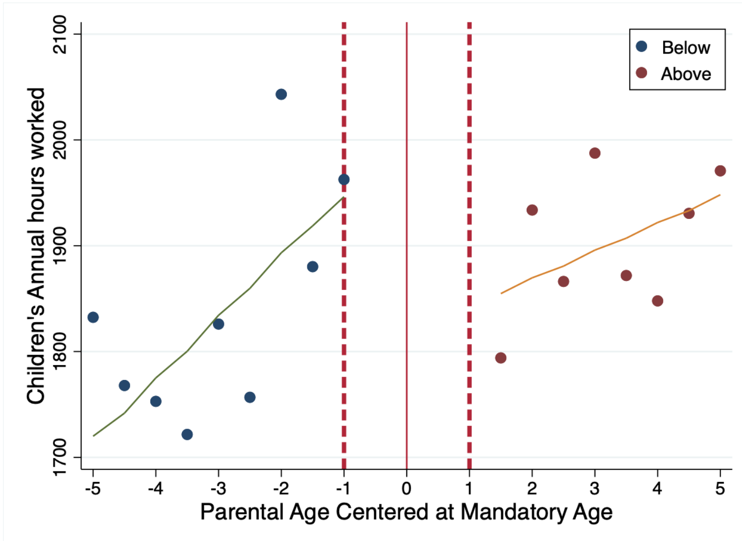
Since retirement is anticipated, it is possible that people adjust their behavior ahead of time. For example, adult children may increase their labor supply ahead of time in anticipation of their parents' retirement and the potential drop in family income. This will result in an upward bias in our estimate of the labor supply reduction at cut-off. On the other hand, family may choose to reallocate the duties among household members in anticipation of changes in family life. For example, knowing that his or her parent is retiring soon, the child may start to ease out of his/her current role at work to prepare for the transition to a more family-centered role. This will lead to a downward bias in our estimate of the labor supply reduction, especially for women, since they are often the ones expected to transition early into a family role.

To check if our RD estimates are sensitive to anticipation effects, we implement a "donut-hole" RD design. The main idea is to exclude the few observations just above or below the cut-off. One drawback of this methodology is that there is no clear consensus regarding the optimal size of the donut hole. We choose to exclude observations one year above and below the cut-off.

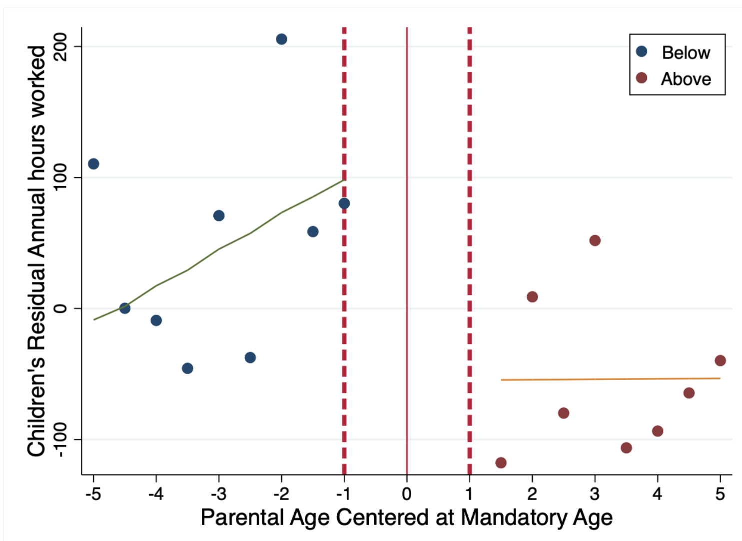
Figure 4 graphically shows that the sizable drop in labor supply still remains after we exclude adult children whose parents are one year above and below the mandatory retirement age. In panel (a), we plot adult children's annual hours of labor supply against the running variable. To partial out own age effect, we also plot the residuals of annual working hours as in model 1. Similar to our main results in Section 4.2, the drop in adult children's working hours remains significant around the cut-off. Table 8 reports the regression results using our donut-hole sample. Column 1 suggests that there is on average an 152-hour drop in adult children's annual working hours when we only consider waged jobs. This effect is larger than the corresponding RD estimate (82.72 hours). When we include people who are self-employed in Column 2, the main effect remains significant, and is also larger than the RD estimates (77 hours). This greater effect suggests that anticipation effects lead to an overall downward bias in our estimate, meaning that the household duty reallocation effect dominates the saving-up for retirement effect.

6.2 Early retirement due to health issues?

If parents are sick and choose to retire early, then the impact of parental retirement on adult's labor supply could be endogenous. To check if our result is driven by the sick parents



(a) Annual hours



(b) Residual annual hours

Figure 4: Robustness: Donut-Hole Design. The x-axis is the parent's age normalized so that zero represents the mandatory retirement threshold. In panel (a), the y-axis is the adult children's annual hours of labor supply. In panel (b), the y-axis is the residual hours of adult children's annual labor supply after controlling for own age effect. Dots are means in 0.5-year bins. Lines are from separate above- and below-threshold linear regressions.

who retire early, we exclude a) adults whose parents retire earlier than the mandatory age (11 percent of the sample), and b) adults whose parents retire earlier than the mandatory age and in bad objective health condition (smoking and drinking heavily, be in hospital in the year) (1 percent of the sample). Table 9 column 1 reports the baseline result in Table

Table 8: Robustness: Donut-Hole RD Design

Dep. var.: Hours	(1) Hired jobs	(2) Hired plus SE
Post	-152.1***	-99.32*
	(53.67)	(53.65)
Running	26.31*	7.431
	(13.15)	(15.68)
Running x Post	-34.90	2.768
	(23.76)	(24.87)
Age_c	41.58***	13.56***
	(3.830)	(3.088)
Constant	160.7	2,030***
	(142.3)	(102.2)
R-squared	0.141	0.008
Windows	5-year with 1-year hole	5-year with 1-year hole
Observations	9,209	5,014

Note: One unit of observation is an adult child. This table reports the robustness check for baseline model excluding observations ±1 year around the cut-off. The dependent variable in Column 1 is adult children's annual hours of labor supply in hired jobs. The dependent variable in Column 2 is adult children's annual hours of labor supply in hired jobs and hours reported as self-employed. 'Post" is a dummy variable that takes value one if an adult's parent has reached the mandatory retirement age and zero otherwise. "Running" is the parent's age minus the his or her corresponding mandatory retirement age. "Age_{it}" is the age of the adult child i's own age in year t. Year fixed effects are included in all columns. Standard errors are reported in parentheses and clustered by adult child birth year. *** p<0.01, ** p<0.05, * p<0.1.

2 column 2 using the entire sample. Table 9 columns 2 and 3 report the estimates when excluding people whose parents retire early and sick and retire early, respectively. Table 9 shows that the negative result on hours still holds. So this relieves the concern of reverse causality due to early (sick) retirement.

6.3 Alternative time window

As discussed in the sample construction subsection in Section 3, there is no statistical or economic consensus on the choice of the window size in RD design. To check the robustness of our results, we consider an alternative time window of ±7 years around the mandatory retirement cut-off for parents.

Table 10 reports the baseline estimates for Model 2 using our ±7 years sample. The drop in adult children's labor supply at the cut-off remains statistically significant. The magnitudes are also consistent with our baseline results.

Table 9: Robustness: Excluding Early Retirement

Dep. var.: Hours	(1) Hired jobs	(2) Excluding early retirement	(3) Excluding early and sick retirement
Post	-81.50***	-91.88***	-77.65**
	(27.63)	(28.17)	(28.73)
Running	-2.86	4.04	-4.94
	(10.82)	(11.06)	(10.96)
Running x Post	14.86	-0.759	17.15
	(17.67)	(20.58)	(17.37)
Age_c	12.47***	15.13***	12.25***
	(2.26)	(2.42)	(2.25)
Constant	2,041***	1,961***	2,040***
	(75.90)	(84.32)	(74.87)
Observations	7,573	5,319	7,512
R-squared	0.103	0.097	0.104
windows	5	5	5

Note: One unit of observation is an adult child. This table reports the robustness check for baseline model excluding observations. Column 2 excludes adults whose parent retire earlier than the mandatory age. Column 3 excludes adults whose parent retire earlier than the mandatory age and in bad objective health condition (smoking and drinking heavily, be in hospital in the year). The dependent variable in all columns is adult children's annual hours of labor supply in hired jobs. 'Post" is a dummy variable that takes value one if an adult's parent has reached the mandatory retirement age and zero otherwise. "Running" is the parent's age minus the his or her corresponding mandatory retirement age. "Age_{it}" is the age of the adult child i's own age in year t. Year fixed effects are included in all columns. Standard errors are reported in parentheses and clustered by adult child birth year. *** p<0.01, ** p<0.05, * p<0.1.

6.4 Alternative model specification

Since the dependent variables in Model 3 and Model 4 are binary variables, we check if our results are sensitive to model specification. In particular, we re-run the regressions in Model 3 and Model 4 using Probit model.

Table 11 reports the estimated marginal effects of parental retirement on the probability of giving (receiving) transfers to (from) parents with Probit model, using our original ±5 years sample. The estimates are slightly larger in magnitude than the effects in 4 and are still significant.

Table 12 reports the marginal effect estimates using Probit model for gender-specific transfer probabilities. The coefficients are largely consistent with our estimates in Table 5. In columns 5 to 8, we still find disparate transfer patterns for daughters and sons in terms of receiving help from parents. Columns 1 to 4 compare the probabilities of providing help to parents by gender. Although the probability of sons providing upward transfers after

Table 10: Robustness: Seven-year window

Dep. var.: Hours	(1) Hired jobs	(2) Hired plus SE
Post	-113.20***	-85.05***
	(32.15)	(28.26)
Running	14.98***	1.45
	(5.41)	(6.12)
Running x Pose	-17.64*	9.255
	(9.86)	(8.08)
Age_c	37.09***	11.70***
	(3.58)	(2.36)
Constant	205.80	2,045***
	(135.20)	(78.19)
R-squared	0.156	0.099
windows	7	7
Observations	15,010	10,031

Note: One unit of observation is an adult child. This table reports the robustness check for baseline model using ±7 years as an alternative window. The dependent variable in Column 1 is adult children's annual hours of labor supply in hired jobs. The dependent variable in Column 2 is adult children's annual hours of labor supply in hired jobs and hours reported as self-employed. 'Post" is a dummy variable that takes value one if an adult's parent has reached the mandatory retirement age and zero otherwise. "Running" is the parent's age minus the his or her corresponding mandatory retirement age. "Age_{it}" is the age of the adult child i's own age in year t. Year fixed effects are included in all columns. Standard errors are reported in parentheses and clustered by adult child birth year. *** p<0.01, ** p<0.05, * p<0.1.

parental retirement is higher using Probit model compared to linear probability model, the magnitude is still smaller than that of daughters. Thus, the disparate transfer patterns between male and female children remain robust to alternative model specification.

Table 13 reports the estimated marginal effects of retirement on parents' self-rated health using an Ordered Probit model. Column 1 to 4 report changes in the likelihood of considering oneself as "very healthy" to "less healthy", using "very unhealthy" as the baseline. Column 1 suggests that parents are less likely to positively rate themselves as healthy after retirement after controlling for their risky health behaviors (drinking and smoking). The 4.4 percent drop in feeling very healthy (rate as 1) is very close to the corresponding estimate in column 1 of Table 6. Estimates in column 2 and 4 are similar to those in Table 6 as well. Thus, our estimates of changes in parents' self-rated health are also robust to alternative model specification.

Table 11: Robustness: Transfer

	(1)	(2)	(3)	(4)
	Ever transfer to parent		Ever receive from parents	
Dep. var.	Money	Housework	Money	Housework
Post	0.054***	0.053***	0.047***	0.073***
	(0.017)	(0.014)	(0.014)	(0.017)
Running	0.000	0.003	0.002	-0.003
	(0.004)	(0.003)	(0.004)	(0.004)
Running x Post	0.011***	-0.005	-0.002	0.013***
	(0.005)	(0.005)	(0.005)	(0.006)
Age_c	0.009***	0.003*	-0.006***	0.012***
	(0.001)	(0.001)	(0.002)	(0.001)
Log Likelihood	-2430.647	-2397.704	-2150.9	-2612.681
Year FE	yes	yes	yes	yes
windows	5	5	5	5
Observations	4,773	4,773	4,773	4,773

Note: This table is the robustness check for Table 4 using Probit model. Marginal effects are reported in the first row, and standard errors are reported in parentheses. One unit of observation is an adult child. The dependent variables in column 1 and 2 are dummy variables that take value one if the adult child transferred money to or did housework for the parent in the past six months and zero otherwise. The dependent variables in column 3 and 4 are dummy variables that take value one if the adult child received money or housework help from the parent in the past six months and zero otherwise. "Post" is a dummy variable that takes value one if an adult's parent has reached the mandatory retirement age and zero otherwise. "Running" is the parent's age minus the his or her corresponding mandatory retirement age. "Age_{it}" is the age of the adult child i's own age in year t. Standard errors are reported in parentheses and clustered by adult child birth year. *** p<0.01, ** p<0.05, * p<0.1.

Table 12: Robustness: Transfer By Gender

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Ever transfer to parent				Ever receive from parents			
	Money		Housework		Money		Housework	
Dep. var.	Daughter	Son	Daughter	Son	Daughter	Son	Daughter	Son
Post	0.063***	0.050**	0.072***	0.045**	0.031	0.055***	0.019	0.101***
	(0.024)	(0.021)	(0.023)	(0.017)	(0.029)	(0.017)	(0.022)	(0.019)
Running	-0.012	0.007	0.001	0.005	0.002	0.002	0.002	-0.006
	(0.008)	(0.005)	(0.005)	(0.004)	(0.008)	(0.004)	(0.006)	(0.005)
Running x Post	0.015*	0.006	-0.007	-0.005	0.002	-0.003	0.006	0.018**
	(0.009)	(0.006)	(0.010)	(0.005)	(0.010)	(0.005)	(0.010)	(0.007)
Age_c	0.006***	0.010***	-0.001***	0.004***	-0.011***	-0.004***	0.008***	0.013***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	0.002)	(0.001)	(0.001)
Log Likelihood	-779.439	-1625.484	-849.65	-1535.977	-739.102	-1391.821	-868.843	-1661.932
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
windows	5	5	5	5	5	5	5	5
Observations	1,631	3,131	1,631	3,131	1,631	3,131	1,631	3,131

Note: This table is the robustness check for Table 5 using Probit model. Marginal effects are reported in the first row, and standard errors are reported in parentheses. One unit of observation is an adult child. The dependent variables in column 1 (2) and 3 (4) are dummy variables that take value one if the daughter (son) transferred money to, or did housework for the parent in the past six months, zero otherwise. The dependent variables in column 5 (6) and 7 (8) are dummy variables and take value one if the daughter (son) received money, or received housework help from the parent in the past six months, zero otherwise. "Post" is a dummy variable that takes value one if an adult's parent has reached the mandatory retirement age and zero otherwise. "Running" is the parent's age minus the his or her corresponding mandatory retirement age. "Age_{it}" is the age of the adult child i's own age in year t. Standard errors are reported in parentheses and clustered by adult child birth year. *** p<0.01, ** p<0.05, * p<0.1.

Table 13: Robustness: Parental Self-rated Health and Retirement using Ordered Probit Model

Dep. var. Self-rate as:	(1) More Healthy	(2) Moderate	(3) Neutral	(4) Less
Post	-0.044***	0.000	0.006**	0.039**
	(0.019)	(0.000)	(0.002)	(0.017)
Running	0.004	0.000	-0.001	-0.004
	(0.005)	(0.000)	(0.001)	(0.004)
Running x Post	0.008	0.000	-0.001	-0.007
	(0.006)	(0.000)	(0.001)	(0.006)
Smoke in recent 1 mon	0.032**	0.000	-0.004**	-0.027**
	(0.014)	(0.001)	(0.002)	(0.012)
Drink more than 3 times a week	-0.011	0.000	0.001	0.010
	(0.012)	(0.000)	(0.002)	(0.011)
	0.360	0.458	0.361	0.360
Log likelihood = -7181.432				
N = 6073				

Note: This table is the robustness check for Table 6 with ordered probit model. Marginal effects are reported in the first row, and standard errors are reported in parentheses.
One unit of observation is a parent. The dependent variables in column 1-4 are indicator variables of self-rated health: "Very Healthy" (value 1), "Moderately Healthy"(value 2), "Neutral"(value 3), "Less Healthy" (value 4). "Very Unhealthy" is used as the baseline. "Post" is a dummy variable that takes value one if an adult's parent has reached the mandatory retirement age and zero otherwise. "Running" is the parent's age minus the his or her corresponding mandatory retirement age. "Smoke in recent 1 mon" and "Drink more than 3 times a week" are parents' risky healthy behaviors that are included here as control variables. Standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

7 Concluding Remarks

This paper studies the impact of parental retirement on adult children's labor supply and investigates the mechanisms, namely the changes in time and monetary transfers between parents and adult children due to parental retirement. We exploit the exogenous mandatory retirement age in China and use a regression discontinuity (RD) design to estimate the intent-to-treat effect of parents reaching mandatory retirement age. We find a significant reduction in adult children's annual hours of labor supply by 3 to 4 percent. The negative effect is especially pronounced for female children.

We find that the parents' self-rated health also experience a sizable drop as they pass the mandatory retirement age. The negative effect is driven by self-rated unhealthy parents. With a lack of formal eldercare provision, parents rely more on adult children and demand more care from them when they are transitioning into retired life. Our results indeed suggest that the upward transfer from children to parents, both in terms of money and in terms of time, increased significantly upon parental retirement. In addition, we find that daughters are more likely to provide money and help to parents while receiving less support from parents compared to sons. This showcases the barrier of traditional gender role and social norm imposes on Chinese women's endeavors in balancing market labor supply and home production.

Our study has two major policy implications. First of all, since formal elderly care and assistance from family members are close substitutes, central and local government should devote more resources into building affordable elderly care facilities so as to alleviate the burden on and career costs to adult children with retired parents. Second, since social norm and traditional gender role dictate Chinese women as the main care-givers, workplace amenities such as flexible working hours and "elderly care days" will help female employees balance the demands from work and family.

Two main limitations exist in our study. First of all, due to the limited scale of the survey and the fact that many respondents failed to report working hours, the number of observations included in our final sample is not large enough for further dissection. For example, with sufficiently large sample size, we could have compared the effects of father's retirement to mother's retirement, or parent's retirement to in-law's retirement. With our sample size, however, the statistical power will be jeopardized. Second, we only observe the extensive margin of inter-generational transfers, not the number of hours or monetary amounts. This limits our ability to quantify the size of upward and downward transfers and the statistical significance of changes in size. Therefore, more research will be required in order to understand the true career cost of parental retirement to adult children and the details of the underlying mechanisms.

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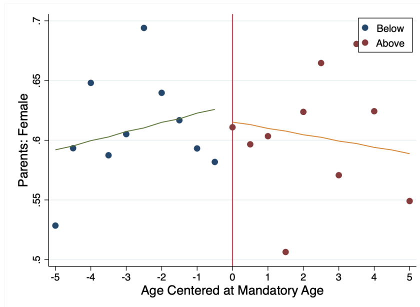
Appendix

Table A1: Balance Test for Missing Hours

	Non-missing hours			missing Hours				
	Mean	SD	N	Mean	SD	N	Diff.	t-stat
Female	0.32	0.47	9009	0.30	0.46	4065	-0.02*	-1.74
Age	27.59	5.00	9009	29.25	5.51	4065	1.67***	17.07
Urban Area	0.47	0.50	8775	0.37	0.48	4048	-0.10***	-10.60
Married	0.40	0.49	9009	0.32	0.47	4065	-0.07***	-8.19
Years of schooling	10.46	4.00	8623	9.00	4.44	4050	-1.46***	-18.54
Income	19992.77	112110.89	8947	4327.64	13988.20	3998	-15665.13***	-8.80
Asset (thsd yuan)	310.10	531.81	8762	181.78	392.48	3998	-128.32***	-13.65
N.kid under age 1	0.05	0.24	9009	0.06	0.25	4065	0.01	1.18
N.kid age 1-2	0.21	0.45	9009	0.22	0.46	4065	0.02*	1.89
N.kid age 3-5	0.27	0.53	9009	0.38	0.62	4065	0.10***	9.55
N.kid age 6-16	0.36	0.66	9009	0.51	0.77	4065	0.15***	11.34
Parent Age (recode)	59.78	2.95	9009	60.33	3.03	4065	0.55***	9.73
Parent Retired	0.26	0.44	6928	0.31	0.46	2778	0.05***	5.34
Post	0.51	0.50	9009	0.58	0.49	4065	0.07***	7.82

Note: This table reports the characteristics of adult children with and without missing working hours.



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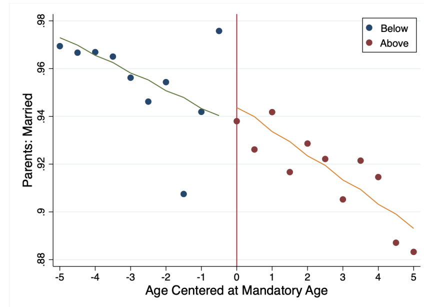

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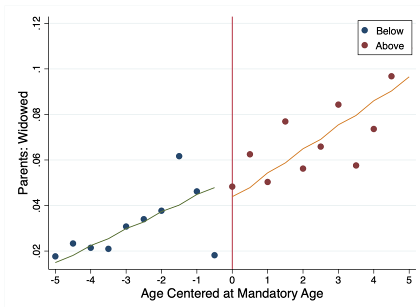

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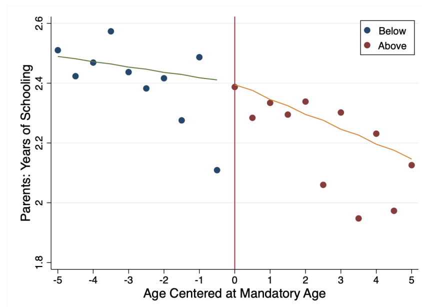

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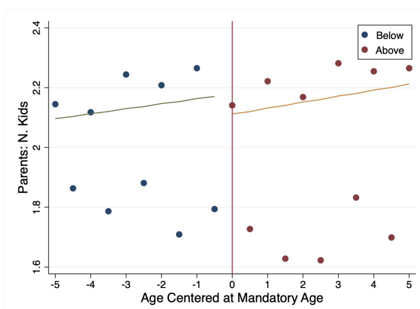

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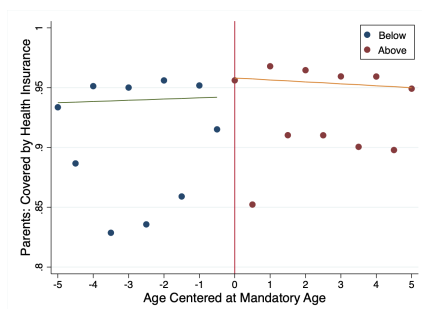

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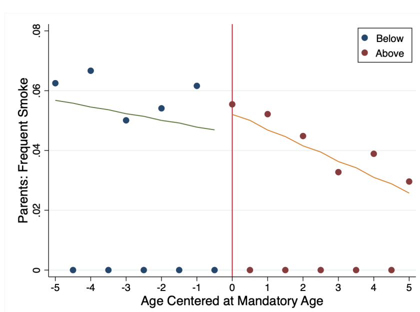

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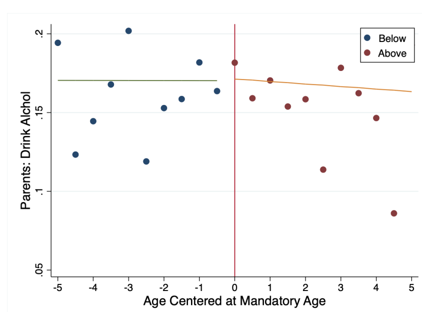

(h)

Figure A1: Validity Test: We plot the change in different covariates of parents below and above the mandatory retirement cutoff. (a) describes the fraction of female; (b) and (c) describe the fraction of individuals who are married and widowed respectively; (d) describes the years of schooling; (e) describes the number of adult children in the family; (f) describes the fraction of individuals whose parents are covered by pension. (g) and (h) describe the fraction of individuals who are frequent smokers and alcohol users respectively.

Table A2: Covariates Smooth at Age Cutoff: Parents

	Marital status							Smoking						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(20)
VARIABLES	Never	Married	Cohabitation	Divorced	Widowed	schooling	N. children	No	Seldom	Frequent	More frequent	Heavy	Alcoholic	Pension
Post	-0.001	0.019*	-0.001	-0.0003	-0.017*	-0.112	-0.099*	-0.009	0.003	-0.021**	-0.003	0.015	0.005	0.013
	(0.002)	(0.011)	(0.002)	(0.003)	(0.010)	(0.114)	(0.054)	(0.019)	(0.024)	(0.010)	(0.017)	(0.012)	(0.026)	(0.012)
Running	0.0003	-0.010***	0.001*	-0.0003	0.009***	0.013	0.013	0.009	-0.007	0.001	0.002	-0.004*	-0.008	-0.004
	(0.0003)	(0.003)	(0.001)	(0.001)	(0.002)	(0.032)	(0.016)	(0.006)	(0.006)	(0.004)	(0.005)	(0.002)	(0.008)	(0.003)
Post x Running	-0.0004	0.0003	-0.002**	0.001	0.001	-0.043	-0.008	-0.001	-0.003	-0.004	0.003	0.002	-1.62e-06	0.007
	(0.001)	(0.004)	(0.001)	(0.001)	(0.004)	(0.037)	(0.027)	(0.009)	(0.009)	(0.005)	(0.006)	(0.003)	(0.012)	(0.005)
Constant	0.002**	0.926***	0.004*	0.005*	0.062***	2.643***	1.980***	0.422***	0.203***	0.090***	0.145***	0.067***	0.193***	0.913***
	(0.001)	(0.010)	(0.002)	(0.003)	(0.007)	(0.093)	(0.050)	(0.024)	(0.024)	(0.011)	(0.014)	(0.008)	(0.034)	(0.011)
Observations	6,073	6,073	6,073	6,073	6,073	6,073	3,421	6,073	6,073	6,073	6,073	6,073	6,073	6,073
R-squared	0.002	0.009	0.002	0.000	0.010	0.026	0.075	0.533	0.045	0.112	0.226	0.114	0.018	0.025
Year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
windows	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Note: This table reports the change in covariates of parents below and above the mandatory retirement cutoff. Here the parent refers to the ”first-to” for “first” retired parent in the household.

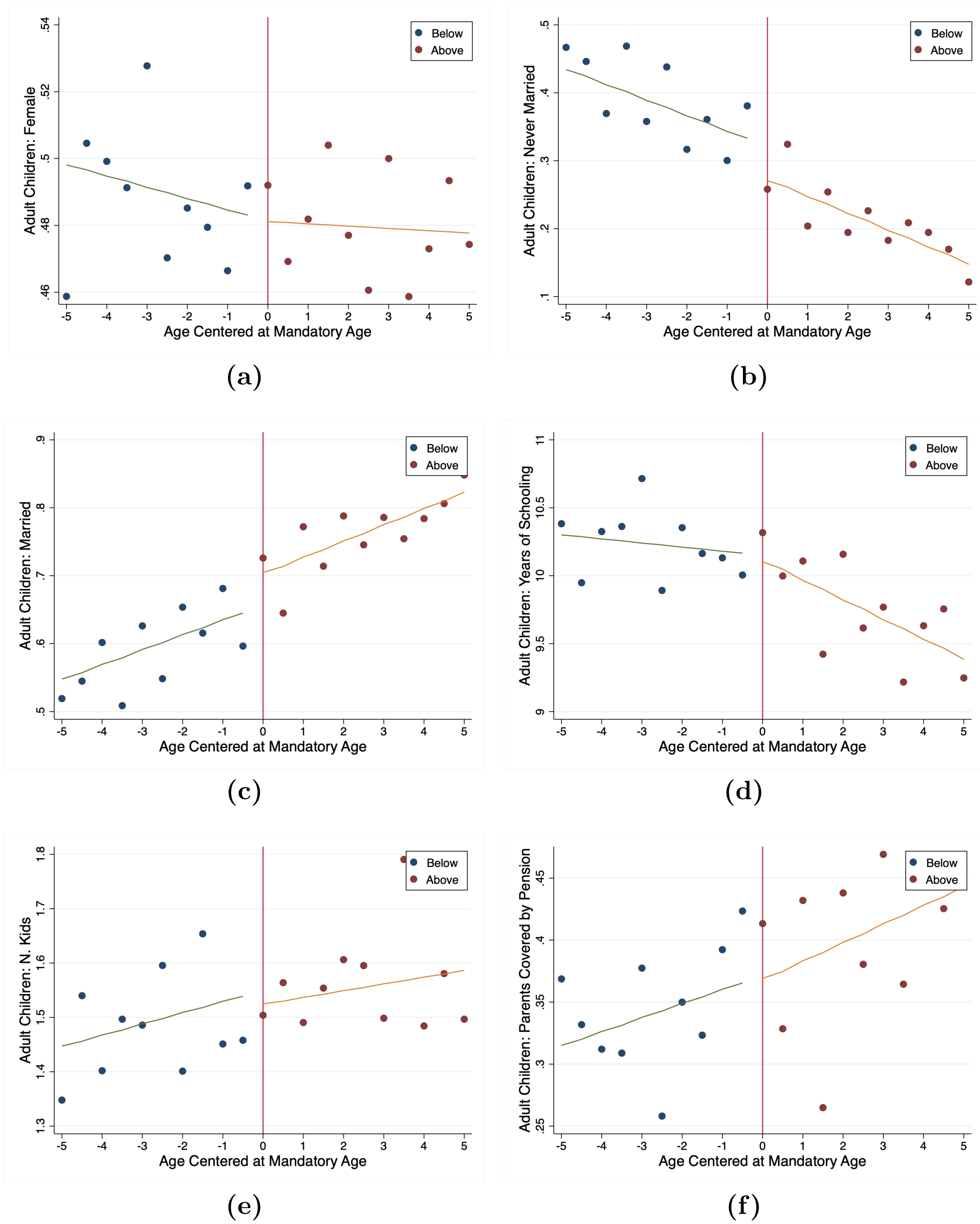

Figure A2: Validity Test: We plot the change in different covariates of adult children below and above parental age centered around the mandatory retirement cutoff. (a) describes the fraction of female adult children; (b) and (c) describe the fraction of individuals who are never married and married respectively; (d) describes the years of schooling; (e) describes the number of children in the family; and, (f) describes the fraction of individuals whose parents are covered by pension.

Table A3: Covariates Smooth at Age Cutoff: Adult Children

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		Marital status					N. Children					Parents covered by
Dep. Var	Female	Never Married	Married	Cohabitation	Divorced	Years of Schooling	Total	N. Age < 1	Age 1-3	Age 3-5	N. Age ≥ 6	Pension
Post	0.005	-0.017	0.016	0.002	-0.003	-0.082	-0.036	-0.004	-0.017	-0.039	0.025	-0.001
	(0.015)	(0.010)	(0.010)	(0.004)	(0.004)	(0.158)	(0.041)	(0.020)	(0.037)	(0.029)	(0.036)	(0.013)
Running	0.003	0.001	-0.001	0.001	0.000	-0.004	0.012	0.002	0.007	0.010	-0.006	0.003
	(0.005)	(0.003)	(0.003)	(0.001)	(0.001)	(0.037)	(0.011)	(0.005)	(0.007)	(0.007)	(0.011)	(0.004)
Running x Post	0.00418	0.007	-0.007	-0.001	0.000	-0.087*	-0.007	-0.003	-0.015**	-0.010	0.019	-0.008
	(0.006)	(0.006)	(0.006)	(0.001)	(0.002)	(0.045)	(0.013)	(0.006)	(0.007)	(0.010)	(0.015)	(0.006)
Constant	0.784***	1.578***	-0.548***	0.023***	-0.053***	11.37***	1.024***	0.442***	1.032***	0.577***	-1.026***	0.804***
	(0.048)	(0.090)	(0.092)	(0.007)	(0.008)	(0.784)	(0.087)	(0.039)	(0.074)	(0.111)	(0.188)	(0.027)
Observations	11,194	11,193	11,193	11,193	11,193	10,717	6,897	6,897	6,897	6,897	6,897	8,438
R-squared	0.013	0.281	0.248	0.002	0.012	0.014	0.013	0.031	0.050	0.007	0.136	0.441
windows	5	5	5	5	5	5	5	5	5	5	5	5
year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

Note: This table reports the change in covariates of adult children below and above parental age centered around the mandatory retirement cutoff. Here the parent refers to the "first-to" for "first" retired parent in the household.