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Children and Parental Health: Evidence from China[1]

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ABSTRACT

In most developing countries children provide some form of insurance against risks when parents are old, which, in turn, justifies parental preference to have more children. In this paper, we examine the causal effect of number of children on several measures of health status of elderly parents using newly available China Health and Retirement Survey data. Because number of children in a family is not exogenously determined, we use a natural experiment (variations in China's one child policy) and preferences for a son to account for exogenous variation in family size. We show that both variation in the one-child policy and having a first born child who is a daughter significantly increase the family size. Overall, our results suggest that having more children has a negative effect on self-reported parental health, but generally no effect on other measures of health. We find no difference between the effect of number of children on maternal and paternal health. We find some evidence that having an adult daughter living at home, or in close geographical proximity, has a positive effect on parental health. The results also suggest that upstream financial transfers have a positive effect on parental health.

Key Words: Children, Parental Health, China, One-child policy, Sex preference

JEL Codes: O12, J13, I10

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Introduction

China is confronting a rapidly aging population. In 2000, the proportion of people of working age (15-59) was one of the highest in the world. However, by 2015, smaller numbers of people will join the labour force, while large numbers retire. As a consequence, the size of the working age population will decline rapidly (UNFPA, 2006). In 2000 the proportion of people aged 60 and above in China (10 per cent) was similar to the rest of the world, but by 2050 this proportion in China is expected to rise to 30 per cent. The absolute numbers of retirees in China are expected to increase from 128 million in 2000 to 431 million in 2050 (UNFPA, 2006). China's old age social security system is still embryonic, meaning that the Chinese elderly are largely dependent on their adult children for support. For people aged 85 and above, almost 80 per cent are dependent on their children or other relatives for financial support. Around 70 per cent of people aged 60 and above live with their children or other relatives and just 0.8 per cent live in institutions (UNFPA, 2006). China's one-child policy, introduced in the late 1970s, is expected to substantially reduce the number of adult children who will be able to look after aging parents in the future. Whether having more children leads to better care for the elderly and how the decline in the number of children is likely to affect the care provided to the elderly in China in the future is a major policy issue for China. The emerging crisis is dramatized by the oft-repeated observation in China that when people currently in the workforce retire, one couple will have to support four parents: the '1-2-4' phenomenon- one child, two parents, four grandparents (World Bank, 1997).

The issue of how the number of children one has affects one's economic circumstances has long been studied in economics. Beginning with Becker and Lewis (1973) and

Becker and Tomes (1976), economists have modelled the number of children as a household choice variable that responds to economic forces. This literature suggests that couples will choose a quantity of children which maximizes their lifetime utility, subject to budget and time constraints. Studies have examined how the number of children one has affects a range of economic and social phenomena. For example, some studies examine how the number of children one has affects one's labour supply and wages (Lundberg & Rose, 2002; Kim & Aassve, 2006). Other studies examine how the number of children one has affects the stability of one's marriage (Jacobsen *et al.,* 2001; Koo & Janowitz, 1983; Li *et al.,* 2009) and the educational and social outcomes for one's children (Haveman & Wolfe, 1995; King, 1987). Similarly, a number of studies have examined how the number of children affects parental health, particularly maternal health (see Hurt *et al.,* 2006). However, these studies have primarily been restricted to the period covering the child's birth and the first few years of the child's life. There are studies in medical and psychology literatures, suggesting that having more children impacts on a range of health conditions of the parents. These health conditions include mental health (see eg. Gove & Geerken, 1977); weight gain and obesity (see eg. Weng *et al.,* 2004); cardiovascular disease (see eg. Zhang *et al.,* 2009*)* and breast and cervical cancer (Pike, 1987; Kelsey *et al.,* 1993; Ness *et al.,* 1994*).* Many of these health outcomes, such as weight gain following the birth of children, have been shown to affect mothers and fathers. There is also much evidence that these health conditions can either persist into old age, such as in the case of weight gain, or only become evident in old age, such as in the case of cardiovascular disease and stroke. The effect of the number of children one has on one's health in old age, however, has not been thoroughly explored.

In this paper we focus on the specific issue of how the number of children one has affects one's health in old age using pilot data from the China Health and Retirement Longitudinal Survey (CHARLS) collected between July and September 2008. As discussed in more detail in the next section, the relationship between the number of children one has and one's health in old age is not clear cut. There are two principal channels through which the number of children one has could impact on one's health in old age. First, there is the direct effect of having children on one's health, which is likely to be negative. Second, children may provide support for their parents in old age, which in turn might have an indirect effect on their parents' health, which is likely to be positive. As the relationship between socioeconomic determinants of health outcomes have been shown to be sensitive to different measures of health (Frijters & Ulker, 2008), we use five health measures – self-reported health, difficulties in performing activities of daily living (ADL), mental health, blood pressure and body mass index (BMI).

How does one's fertility decision affect one's health status in old age?

Direct effects of having children on own health

The direct effect of having children on own health occurs through childbearing (for mothers) and also through raising children (for mothers and fathers). Women in developing countries experience increased health risks associated with childbearing, which increase with the number of children (Menken *et al.*, 2003) According to estimates by Murray and Lopez (1997), maternal disorders account for 2.4 per cent of Disability Adjusted Life Years lost in developing countries, compared to only 0.6 per cent in developed countries. As emphasised by Strauss and Thomas (1998), health is an accumulative outcome. Hence, the effect of children on parents' health during childbirth and when children are young is likely to persist into old age. This observation is

consistent with findings in the medical literature, which suggests that the number of children one has, has implications for parental health in old age.

Children are often regarded as a source of gratification. There is evidence from the economics of happiness literature that having children increases subjective well-being (Dolan *et al.,* 2008). Appleton and Song (2008) found that respondents who had children reported higher subjective well-being in urban China. However, in the psychology literature, there are several studies which suggest that the presence of children has a negative effect on the mental health of the parents (Campbell, 1975; Gove & Geerken, 1977; Radloff, 1975; Rollins & Feldman, 1970). The reason given for this finding is that the presence of children confines parents to a narrowly-defined domestic role, which affects their self-esteem. This is particularly likely to impact on mothers, given that mothers have been the traditional caregivers for young children and are more likely to incur career interruptions to raise children. There is some evidence that interaction with adult children has a positive effect on well-being of older parents, although there are also studies suggesting that adult children are a source of stress to their parents, particularly in cases where there is generational conflict between older parents and adult children, which could have negative effects on parental health in older age (Ward, 2008).

Having children has also been shown to be correlated with weight change. According to the maternal depletion hypothesis, women, especially in developing countries, may suffer from maternal depletion syndrome as the result of childbearing without sufficient time between births for recovery. Both pregnancy and lactation entail considerable expenditure of energy and if the mother cannot sufficiently recover between births, her nutritional status might decline, with long-term health implications. Support for the

maternal depletion hypothesis has been mixed (see studies reviewed in Menken *et al.,* 2003). Overall, there are more studies suggesting that mothers gain weight than lose weight following pregnancy. Several studies have found that having children is a major cause of obesity among women (see studies reviewed in Weng *et al.,* 2004). Mechanisms proposed to explain the association between number of children and obesity in women are metabolic changes associated with pregnancy and physiological changes associated with accommodating living with small children, such as changes in diet and physical exercise. A number of studies have found that having children increases the prevalence of obesity among fathers as well as mothers (Kritz-Silverstein *et al.,* 1997; Weng *et al.,* 2004). The explanation for this finding is that behavioural changes associated with raising young children affect fathers as well as mothers, and that couples with many children may have less opportunity in a time allocation sense to focus on resuming health behaviours that promote weight loss. Weight gain among mothers and fathers when raising young children has been shown to persist into old age. Older men and women who had more biological children are more obese than older men and women who had fewer or no biological children (Kritz-Silverstein *et al.,* 1997; Lahmann *et al.,* 2000).

The number of children one has, has been shown to have mixed effects on the likelihood of getting cancer later in life. The prevalence of cancers of the breast, endometrium and ovaries is lower among women who have many children, but the prevalence of cervical cancer is higher among women with several children (Hurt *et al.,* 2006). Pregnancy and child rearing have been shown to increase the risk of cardiovascular disease among women later in life; however, whether the increased risk is due to metabolic changes in pregnancy or stress associated with child rearing is controversial (Ness *et al.,* 1994). Zhang *et al.* (2009) found that among a large sample of Chinese men and women in

Shanghai, men and women who had more children had a significantly increased prevalence of stroke later in life, after controlling for socioeconomic characteristics and other predictors of stroke. This suggests that the reason for cardiovascular disease later in life may be partly biological, associated with metabolic or physiological changes associated with pregnancy (which affects women), but is primarily related to chronic stress and adverse lifestyle factors associated with child rearing which increase the risk of stroke (which affect both men and women). Raising a child requires more financial commitment and energy which may affect parental health (Berger *et al.,* 2004*).* Studies have shown that men who have young children work longer hours (Pencavel, 1986), which could result in poorer outcomes for health, including stroke, manifest in later life.

Indirect effects on health based on support from children in old age

Children may provide support for their parents in old age, which, in turn, might affect their parents' health (McGarry & Schoeni, 1997). There may be economies of scale in caring for aged parents (Qian, 2009). Children might share the emotional, financial and time commitment costs in terms of caring for aging parents. In China, number of children has been found to be positively correlated to the support aging parents receive and their general well-being (Hermalin *et al.,* 1996; Pei & Pillai, 1999). The strength of the indirect support might also depend on the gender and living arrangements of the children. Studies for western countries have found that women are more likely to feel stronger familial obligations and that daughters are more likely to be involved in care giving for parents (Ward, 2008). This may be different in China where traditionally the daughter gets married and takes responsibility for caring for her parents-in law (Greenhalgh & Bongaarts, 1987; Zhang & Goza, 2005). The level of indirect support provided by children with day-to-day activities is likely to be greater among adult children living at

home or in close geographical proximity to aging parents. However, equally, another form of support is through remittances. Parents who have more children who migrate in search of higher incomes are likely to receive additional financial support from their children in the form of higher remittances. Alternatively, parents who have many children can encourage specialisation among those children in giving support. Some children can specialize in care giving to parents in daily activities, while other children can migrate and specialize in providing financial support through remittances.

There is a well-recognised quantity-quality trade-off in terms of number of children (Becker & Lewis, 1973; Becker & Tomes, 1976). Having more children can be expected to lower their children's education/health and labour market prospects, which may translate into lower capacity of the children to support their parents in old age. Li *et al.* (2008) and Rosenzweig and Zhang (2009) find evidence of a quantity-quality trade-off in China, although Qian (2009) suggests that quantity and quality may be complements. There is also a possible moral hazard argument; parents with more children might take less care of their health because their children to look after them in old age.

Data

CHARLS is the first publicly available data set on the elderly in China (see Zhao *et al.*, 2009). It provides a wide range of information about household characteristics of the elderly as well as individual information on elderly respondents, their spouses and children. The household survey is composed of seven parts: (a) demographic background; (b) family; (c) health status and functioning; (d) health care and insurance; (e) work, retirement and pension; (f) income, expenditure and assets; and (h) interviewer observation. CHARLS contains data from 1,563 randomly selected households collected

from two provinces, Zhejiang and Gansu, between July and September 2008. CHARLS sampled one person aged 45 and over, plus their spouse if one exists, in each household with an age-eligible person. Hence, overall CHARLS contains information on 2,951 individuals aged 45 and older. Gansu and Zhejiang were chosen as the two provinces as one is representative of an inland, poorer province and the other is representative of a prosperous coastal province. Gansu, in the northwest of China, is one of the poorest provinces in China and has a large rural population. Zhejiang, on the South-eastern coast, in contrast, is one of the leading centres of Chinese industrialization and is far more urbanized than Gansu province and has a much higher proportion of exports. Incomes in Zhejiang have risen more rapidly than the Chinese average.

County level units are chosen by Probability Proportional to Size (PPS), stratified by whether the unit was an urban district (*qu*) or rural county (*qian*) and by region within each classification. Both urban districts and rural counties can contain both urban and rural communities, but the concentration of urban and rural populations differs between the two. With the objective of sampling 16 county-level units per province, the number of counties to be sampled in each stratum was determined based on population size. Counties were randomly selected within each stratum with PPS measured by population. Based on this sampling procedure, between 25 and 36 households in each community containing at least one individual aged 45 or above was selected and either one or two individuals in each household were interviewed depending on marital status in the household. Table 1 contains descriptive statistics for the number of children and other control variables used in the regression that potentially explain the health status of the respondents. Most of the control variables that we employ are standard in the literature examining determinants of health status (see eg. Case *et al.,* 2005). Specifically, we

control for age, gender, education, marital status, place of residence (urban/rural), number of children and number of siblings. Yamashita (2008) finds that sibship size predicts some health outcomes in later life among a sample of the Mexican elderly. We use household consumption expenditure, rather than household income, as a control variable. The former is a better proxy for permanent income and is better proxy in our context since in our sample we have many households which are retired and do not have any current income. Since health status as one gets older might be affected by the level of one's assets, with more assets generally implying better opportunities to seek medical care, we control for household total wealth. Equally importantly, we also control for respondents' health status during childhood using self-reported health status during childhood. A respondent's health status during childhood would also indicate their living conditions during childhood with implications for health later in life (Case *et al.*, 2005).

Insert Table 1

In examining the health status of the elderly in China, the CHARLS data has the advantage that it contains a rich set of variables on health status that would otherwise be difficult to obtain. We use five alternative, albeit related, measures of health status, similar to the approach adopted by Frijters and Ulker (2008). As our first measure, survey respondents are asked to rate their current health status on the Likert scale where 1 = excellent health (2.56 per cent), 2 = very good health (11.18 per cent), 3 = good health (20.55 per cent), 4 = fair health (40.23 per cent) and 5 = poor health (25.47 per cent). Our second measure of health status is ADL, which is a composite index of the level of difficulty that the respondent has in performing a number of fairly normal and routine day-to-day activities or tasks. Specifically, we considered the degree of difficulty

experienced by the respondent in performing the following 20 tasks: dressing, bathing, eating, getting in or out of bed, walking 100 metres, walking one kilometre, sitting for two hours, getting up from a chair, climbing several flights of stairs, stopping, kneeling or crouching, lifting 10 *jin* (equivalent to a heavy bag of groceries), extending one's arm, pushing or pulling large objects, urinating, doing household chores, preparing hot meals, shopping for groceries, managing money, making phone calls and taking medicine. Respondents' answers were coded: 1= 'I do not have any difficulty in performing the task'; 2= 'I can perform the task, but only with difficulty', 3= 'I cannot perform the task'. Our measure of ADL is the sum of responses on all 20 tasks. Responses were normalized so that the maximum value of the composite ADL variable is 1 and the minimum value is zero. The mean value of ADL is 0.078 with a standard deviation of 0.129.

Similarly our mental health variable is a composite measure where respondents were asked about whether they had experienced a range of mental health symptoms in the past week. Specifically, respondents were asked if they felt bothered by things that do not usually bother them; had trouble keeping their mind on what they were doing; felt depressed; if everything that they did in their life was an effort; if they felt fearful; if their sleep was restless; if they were happy; if they felt lonely; if they felt sad; and if they could not get going. Responses were coded as 1= 'rarely or none of the time'; 2= 'sometimes'; 3= 'a moderate amount of time'; and 4='most or all of the time'. This variable is also normalized so that it takes a value between zero and 1. The mean value of the mental health variable is 0.239 with a standard deviation of 0.211.

We also use the BMI and blood pressure. Less than 5 percent of the people in the sample are underweight. Hence, we merged them into the 'normal' weight group and simply use

whether a person is of normal weight or overweight, where overweight is defined as having a BMI greater than 25. This also allows us to estimate a simple probit model in which the BMI variable takes a value of 1 if overweight and 0 if normal/underweight. To measure blood pressure, the blood pressure of the individual was taken three times and we take the average of these blood pressure measures to determine whether an individual has high or normal blood pressure. We convert the blood pressure variable into a binary variable, which is equal to 1 if a person has high blood pressure (above 140/80) and zero otherwise.

In Figure 1 we plot the health status of parents against their number of children. Figure 1A shows that ADL goes up as the number of children increases after one child. For parents with one child, however, ADL is smaller than having no children or two or more children. This indicates that functional status of a person is lowered with number of children beyond one, and it is also lower for those with no children. Figure 1B shows that the BMI is almost the same for parents with children. The BMI for parents with 8 children is very low, but this may not be a reliable measure as there are few observations for parents with this number of children. We also find that self-reported health status does not vary much with the number of children (Figure 1C), but mental health improves with the number of children (Figure 1D). Figure 1E shows that blood pressure falls for those with one child, but increases for those with two or more children.

Empirical Strategy

We estimate the following health equation

$$HEALTH = \beta_0 + \beta_1 CHILD + X\beta_2 + \upsilon \quad (1)$$

where *HEALTH* is the health status of the respondent (aged 45 or older)[3], *CHILD* is the number of children which the respondent has and *X* is a vector of variables that measure respondent characteristics (age, gender, *hukou* status, marital status, education, health status during childhood, consumption expenditure, wealth, number of siblings and location of residence). Using health status during childhood potentially controls for standard of living at that age. It also takes into account if health or living conditions during childhood is correlated with health status later in life. Estimating Equation (1) using ordinary least squares (OLS) is likely to yield biased results because the unobserved attributes that are correlated with the household's fertility decision are likely to be correlated with the health status of the individual. The fertility level is endogenously chosen by parents and hence may be related to other unobservable parental characteristics that affect child outcomes. One method for addressing endogeneity of the fertility decision is to use the exogenous variations in number of children that are generated by the natural occurrence of twins to isolate the causal effect of family size (see eg. Li *et al.*, 2008; Rosenweig & Wolpin 1980; Rosenzweig & Zhang, 2009). However, using twins to instrument the number of children requires a dedicated twins dataset (such as the Chinese Child Twins Survey) or a very large dataset as the occurrence of twins in the population is very rare. CHARLS does not focus on twins data; hence, we were not able to use twins as an instrument for fertility.

We use two instruments. The first is the gender composition of the children. This is an appropriate instrument for the number of children because gender is exogenously determined. Previous studies set in western contexts have argued that parents prefer to

[3] One possible shortcoming of our approach is that we only consider health of parents who survive to old age. To the extent the number of children one has affects his/her mortality our estimates would be downward biased.

have children of both genders. Thus, if the first two children are boys (or girls) they will be more likely to have a third child in the hope that it is of the opposite gender to those they have. The gender composition of the children has previously been used to instrument for the number of children in several studies (Angrist & Evans, 1998; Angrist *et al.,* 2009; Black *et al.,* 2005; Conley, 2004). Chinese parents have a preference for sons (Arnold & Liu, 1986). Hence our instruments for the gender composition of children are if the first child is a daughter and if the first two children are daughters. Parents whose first child is a daughter or first two children are daughters will want to have another child in the hope that child is a son. We show that there is a significant and robust relationship between these two instruments and family size. Our instruments are also natural candidates to satisfy the exclusion restriction. Employing these variables as instruments we have the following first stage regression specifications:

(2a) $$CHILD = \alpha_0 + \alpha_1 GIRL + X\alpha_2 + \mu$$

(2b) $$CHILD = \alpha_0 + \alpha_1 TWOGIRLS + X\alpha_2 + \mu$$

In Equation (2a) *GIRL* is a dummy variable indicating that the first child born is a daughter. In Equation (2b) *TWOGIRLS* is a dummy variable indicating that the first two children are daughters.[4] Our second instrument for family size is based on China's one-child policy. Beginning in 1972, the policy 'Later [age], longer [the spacing of births], fewer [number of children]' was introduced as a precursor to the one-child policy. This

[4] One potential concern with our instrument is that gender of a child directly affects the health status of parents. We argue that conditional on the number of children, gender of a child should have no independent effect on health of parents. In the next section, we also show that is the case. Moreover, the same instrument has been used widely in the literature in similar contexts. For example, Angrist and Evans (1998) use the gender composition of children as an IV to estimate the effect of the number of children on parental labour supply.

earlier policy offered economic incentives to parents who spaced the birth of their children at least four years apart (Qian, 2009). The one-child policy, which was introduced in 1979, applied to individuals of Han ethnicity, who constitute 92 per cent of the Chinese population. It banned second births except in exceptional circumstances. One unintended consequence of the one child policy was that reports of female infanticide became widespread (Banister, 1987). To address this problem, the one-child policy was partially relaxed to allow for regional variation in family planning policies and the 'one-son-two-child' rule in some locales, which allowed rural couples to have a second child if the first child was a girl. Most of the respondents in the CHARLS dataset are Han Chinese . Hence, there is little variation in the ethnicity of respondents. In Zhejiang, more than 99 per cent of residents are Han Chinese. Gansu has Tibetan minority counties, but due to concerns about political sensitivity and problems associated with language barriers, Gansu's nine Tibetan minority counties (eight rural counties and one urban district) were excluded from the survey. Hence, our second instrument for family size is the 'one-son-two-child' rule, which allowed rural couples to have a second child if the first child was a girl. The first stage estimation is given by:

$$CHILD = \alpha_0 + \alpha_1 RURAL * GIRL * POLICY + X\alpha_2 + \mu \quad (3)$$

where *RURAL* is a dummy variable =1 if a child was born in a rural area, *GIRL* is a dummy variable indicating if the first child was a daughter and *POLICY* is three different dummy variables corresponding to whether the child was born before 1973, 1976 or 1979. Qian (2009) makes the point that most studies assume the one-child policy only affected family size for cohorts born after 1979. However, as Qian (2009) argues, if the previous four-year birth spacing law was enforced, the one-child policy should be

binding for those born in 1976 and after. We also consider children born before 1973 to further allow for the effects of the 'Later [age], longer [the spacing of births], fewer [number of children]' on parental preferences with respect to birth spacing. If the child was born before 1973, it is conceivable that the parents were still planning to have a second child when the one-child policy was introduced in 1979, as in the intervening period they were being encouraged to increase spacing between first and second births. In all cases, we only consider groups of mothers not older than 35 years in 1979.

The first stage results for Equations (2a), (2b) and (3) were estimated using OLS. However, the health status variable in the second stage is either ordinal (self-reported health), dichotomous (BMI, blood pressure) or censored (ADL, mental health). Both ADL and mental health variables are continuous variables which have been normalized between zero and one and many individuals reported that they had no problems. We correct for endogeneity using reduced form residuals in the second stage (Vella, 1993). We first obtain generalized residuals using OLS for the reduced form first stage equation and then use the estimated residuals as an additional regressor in the second stage. The second stage is estimated using an ordered probit model when the health variable is self-reported health or an probit model when the health variable is BMI or blood pressure. For ADL and mental health we use a Tobit model to account for the zeros.

Results

We first present the results without allowing for endogeneity of fertility in Table 2. Each specification in Table 2 use covariates at the household and individual level as controls. The coefficient on the number of children is positive and significant when the dependent variable is self-reported health, ADL and BMI, but insignificant when the dependent

variable is blood pressure or mental health. These results suggest that respondents who have more children have statistically lower self-reported health, statistically more difficulties in performing activities associated with daily living and are statistically more likely to be overweight *ceteris paribus.* However, as discussed above, number of children is an endogenous variable. Below we report results that address this issue.

Insert Table 2

Before we present instrumental variable (IV) estimates we check the reliability of our instruments. An important concern with the IV approach is the possible use of weak instruments which tends to bias second-stage estimates and may weaken standard tests for endogeneity. The existing econometric literature defines weakness of instrument based on the strength of the first-stage equation (e.g., Staiger and Stock, 1997; Stock and Yogo 2005). Reliability depends on the relevance and validity of the instruments. Specifically, we test whether the IVs are correlated with the endogenous regressor and orthogonal to the error process. We test the first condition by examining the fit of the first-stage reduced-form regression on the full set of instruments - both included and excluded instruments. First, we estimate an OLS regression for fertility. The first stage results, in which number of children is regressed on *GIRL, TWO GIRLS* and *RURAL*GIRL*POLICY,* together with control variables, are reported in Table 3. The first-stage results show that the instrument is statistically highly significant in all cases except when we use first child is a son (results not reported) or first two children as the instrument. This means that having a first-born daughter or the first two children being daughters increase family size but not vice-versa. Meanwhile, having a son has no effect

on family size. The results using the one-child policy with various time dummies indicate that the relaxation of the one-child policy increases the family size.

The second condition to have a valid instrument is to satisfy the exclusion restriction. In our case, this means that the instrument (gender preference or one-child policy) affects health only through an increase in family size. As mentioned before, a number of studies have used these instruments in similar contexts in China. The exclusion restriction is not directly testable. We estimate a semi-reduced-form equation, in which fertility is instrumented, but the instrumental variable(s) enter the second-stage regression directly (and naturally in the first-stage regression) to examine if the instruments have an independent effect on parental health. The results do not indicate any significant effect of son preference or one-child policy on parental health in any of the specifications. We also estimate a reduced-form regression, in which we regress various health status variables on son preference and the one-child policy as well as other excluded instruments and do not find any statistically significant effect.[5] Thus, overall, both the first stage and reduced form regression results support the use of our instruments.

Insert Table 3

The IV estimates in which health status is regressed on number of children and control variables are reported in Table 4. Overall, the results suggest that respondents who have more children have statistically lower self-reported health at the 10 per cent level or better when number of children is instrumented using the *POLICY* variables. However, for the other measures of health, the results suggest that number of children have no

[5] These results are not reported here, but they are available upon request.

significant effect on ADL, mental health, BMI or blood pressure. These results are generally robust across a number of possible instruments for number of children. The only exceptions are two instances when health is measured using ADL. When number of children is instrumented using *TWO GIRLS*, respondents with more children have less difficulties in performing activities associated with daily living. When number of children is instrumented using *GIRL*RURAL* 1979*, respondents with more children have more difficulties in performing activities associated with daily living. There is one instance when number of children statistically affects health when health is measured using blood pressure. When number of children is instrumented with *TWO GIRLS*, respondents with more children are statistically less likely to have high blood pressure.

Insert Tables 4 & 5

Table 5 shows the results in which the effect of number of children on mothers' health and fathers' health is considered separately. The rationale for distinguishing between mothers' and fathers' health is that it is possible that mothers experience more direct health problems later in life from having children. For example, obesity later in life may be more prevalent among mothers than fathers (Weng *et al.*, 2004) and cardiovascular disease later in life may be more prevalent among mothers than fathers (Zhang *et al.* 2009). There is also evidence that parent-child strains have a greater effect on mothers than fathers, with possible adverse effects on the mental health of mothers (Ward, 2008). The results in Table 5, however, are similar to the more aggregated picture in Table 4. When number of children is instrumented using *RURAL*GIRL*1973* and *RURAL*GIRL*1979*, both mothers and fathers with more children have lower self-

reported health. For the other measures of health, having more children generally has no effect on the health of either mothers or fathers. The exception is when the number of children is instrumented using *RURAL*GIRL*1979.* In this case, fathers with more children have lower mental health and are more likely to be obese, though, in both instances, the coefficient is only weakly significant (at the 10 per cent level).

Next, we investigate whether parental health is affected by adult children (over 18 years of age) living with them at home or in the same locality/village. The level of indirect support provided by children is likely to be greater among adult children living at home or in close geographical proximity to aging parents. The results are reported in Table 6. The results given in the first two columns do not control for endogeneity. The results suggest that if adult children are living with, or in close geographical proximity, to their parents, parents' mental health is better, but, at the same time, parents are more likely to be obese. The latter result is an instance in which extra care provided by children results in a poorer health outcome. The presence of adult children living at home, or in close geographical proximity, has no effect on the other health variables.

In Table 6, we also investigate if the amount of upstream financial transfer has an effect on parental health. Previous studies suggest that upstream financial transfers are substantial in East Asia with about 60-70 per cent of parents receiving money from adult children (Lillard & Willis, 1997). We find a positive correlation between the amount of upstream transfer and parental health on most health indicators. Specifically, the amount of upstream financial transfer is positively correlated with self-reported health, ease of performing day-to-day activities and mental health, although there is a negative correlation with blood pressure. Ravillion and Dearden (1988) find that transfers on the

Indonesian island of Java are generally targeted towards the elderly who have a pre-existing illness. Several other studies for East Asian countries have found parental health to be a significant predictor of upstream financial transfers (see Logan & Bian, 2003 for a review). Hence, one possible explanation for the result for blood pressure is that parents who receive financial transfers might have a pre-existing illness, manifest in the form of having high blood pressure, and hence causation runs in the opposite direction.

Insert Table 6

In order to take account of potential reverse causality we instrument both the financial transfer and adult child living with, or in close geographical proximity to, parents variables separately by the child's educational status. The results are reported in columns (3) and (4) of Table 6. The first stage results where each of the two variables is instrumented separately by child education, are reported in the right-hand side of the bottom panel of the table. The first-stage results show that the instrument is highly statistically significant.[6] The second-stage results are reported using the residuals from the first stage as an additional regressor. In column (3) living with, or in close geographical proximity to a child, has no effect on parental health for any indicator of health. The results for the amount of transfer are similar to the results without instrumenting. Financial transfers are a substitute for time transfers. For example, an adult child with a high opportunity cost of time may prefer to purchase home health care

[6] Although our instrument satisfies the first requirement – correlation, satisfying the exclusion restriction is a concern. We include all variables including income and wealth as independent controls that have previously been used as excluded instruments for health. However, if unobservables that are correlated with health status of parents are also correlated with child education then this would bias our estimates. Although such bias makes the resulting point estimates not useful for policy analysis, we can potentially use the point estimates to address our question here. In particular, as we see below the IV estimates are not different from our earlier estimates that do not use IV.

for his or her parents over spending time assisting his or her parents (Couch *et al.*, 1999; Zissimopoulos, 2001). Previous studies for Chinese societies have found that upstream financial transfers are a substitute for time transfers to parents (Freedman *et al.*, 1978). Our results suggest that upstream financial transfers are generally more effective than co-residence or living nearby in improving parental health. This said, upstream financial transfers have been shown to be a potential source of parent-adult child strain in cases where parents and children bargain over the amount or children feel resentful of familial obligations (Ward, 2008). If the amount of upstream financial transfer is a potential source of parent-adult child strain, this could be the reason for the finding in this study that parents who receive financial transfers have higher blood pressure.

The results in Table 6 indicate that living with, or in close vicinity, to an adult child do not have a positive effect on parental health. Next we consider whether parents who have an adult daughter living at home or in close geographical proximity enjoy better health. In western contexts, women have been described as *kinkeepers* who feel stronger family obligations, maintain family bonds and are most involved in assistance and care giving (see Ward, 2008 and references cited therein). As discussed above, this may be different in China where traditionally the oldest son and his spouse have had the responsibility of caring for older parents. As recently as 1992, a survey of older residents in Beijing found that almost two-thirds (64 per cent) agreed with the traditional view that: 'Having sons makes one's old age secure' (Chen & Silverstein, 2000). However, recent research finds that in China daughters provide better quality care to elderly parents than do sons. Daughters in China have been found to be more emotionally attached to their parents and more willing to help with routine day-to-day activities (Ng *et al.*, 2002; Sun, 2002). For example, in a study in Northeast China, Wang (1999) found that the elderly tend to feel

daughters are more considerate and caring, whereas sons are less sensitive to their parents' needs. The study also found that while sons were more likely to make financial transfers, daughters were more commonly involved in helping on routine activities.

Insert Table 7

The results when parental health status is regressed on whether an adult daughter is living at home or nearby are presented in Table 7. The variable of interest is a dummy variable, which is equal to one if the adult daughter is living at home or in close geographical proximity to her parents and zero otherwise. The results are presented with and without controlling for the number of children (not instrumented), but in each case includes all other control variables included in previous regressions. The results indicate that having an adult daughter living at home, or in close geographical proximity, has a positive effect on self-reported health and mental health, but number of children has a negative effect on those measures. The results are similar to the non-instrumented results for having an adult child living at home or in close-proximity. There are no obvious benefits to parental health of having a daughter over having a child of either gender live nearby.

Conclusion

It is believed that in developing countries the fertility of parents is greatly influenced by the need to have support in old age. In this paper we investigate how fertility affects the well-being of parents in their old-age by examining their health status. Overall, our results suggest that having more children has a negative effect on self-reported parental health, but generally no effect on other measures of health. This finding is robust to

alternative instruments for the number of children. We find no difference between the effect of number of children on maternal and paternal health. We also find that having an adult child (or specifically an adult daughter) living at home, or in close geographical proximity, generally has no effect on parental health; however, in the main, upstream financial transfers have a positive effect on parental health.

The combination of longer lives for the elderly and fewer children, as a result of the one-child policy in China has raised serious concerns about who is going to care for China's aging population in the future. Jiang (1995) estimates that longer life expectancies and fewer children will quadruple the burden of caring for the elderly in China in the second half of the twenty-first century. However, an only child may feel more altruistic to his or her parents and be more willing to make transfers to parents in their old age, consistent with the altruistic motive (Barro, 1974; Becker, 1974). Alternatively, with fewer children, the well-known quantity-quality trade-off suggests parents will invest more in their children. As a consequence, children may be more willing to repay their parents with transfers as their parents age, consistent with the exchange motive (Bernheim *et al.,* 1985; Cox, 1987). Increasing incomes with China's rapid economic growth has increased the opportunity cost of adult children and been the catalyst for the breakdown in traditional family structures (Logan & Bian, 2003). In these circumstances, children will make financial transfers in lieu of time transfers to their parents. Our results indicate that financial transfers generally have a better effect on parental well-being than time transfers when parental well-being is measured by health status. These findings suggest that upstream financial transfers are an effective means of addressing the well-being concerns of China's aging population in the face of declining number of children.

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Table 1: Descriptive statistics

	Zhejiang		Gansu	
VARIABLES	Mean	S.D.	Mean	S.D.
Number of children	2.585	(1.412)	3.935	(2.073)
Number of siblings	3.648	(1.829)	3.935	(2.073)
Age of household head	59.28	(10.71)	58.08	(9.943)
Gender (male=1)	0.534	(0.499)	0.521	(0.500)
Marital status (married=1)	0.857	(0.350)	0.835	(0.371)
Hukou status (rural =1)	0.808	(0.394)	0.813	(0.390)
Years of schooling of household head	3.395	(3.410)	3.386	(3.925)
Health during childhood	2.207	(0.932)	2.272	(1.118)
Maximum years of schooling of any member of the household	9.790	(3.198)	9.299	(3.643)
Annual per-capita household consumption expenditure (RMB)	8504	(7121)	5234	(5794)
Household wealth ('000s RMB)	111.4	(246.4)	18.71	(66.87)
Outcome Variable:				
Self-reported health status (1-5)	3.221	(1.405)	3.472	1.641
ADL (0-1)	0.0444	(0.1017)	0.1167	(0.1452)
BMI (0/1)	0.4866	(0.5001)	0.4490	(0.4977)
Mental health (0-1)	0.2137	(0.1738)	0.2682	(0.2435)
Blood Pressure (0/1)	0.3362	(0.4726)	0.3681	(0.4826)
Number of observations	1425		1260	

Table 2: Effect of number of children on parental health status (not instrumented)

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Self-reported health	ADL	Mental health	BMI	Blood pressure
Number of children	0.064**	0.01**	-0.005	0.08**	0.030
	(0.019)	(0.00)	(0.005)	(0.03)	(0.026)
Control variables?	YES	YES	YES	YES	YES
Observations	2352	2304	2304	1818	1832

Each regression also includes a set of controls which uses household and individual characteristics. Huber-White standard errors in parentheses, ** p<0.01, * p<0.05, + p<0.1

Table 3: First-stage results (dependent variable: number of children)

Instrument List	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
First girl	0.235**							
	(0.053)							
Two girls		0.309**		0.326**				0.436**
		(0.071)		(0.073)				(0.071)
Two boys			-0.036	0.044				
			(0.054)	(0.055)				
Girl*rural*73					0.797**			0.693**
					(0.053)			(0.061)
Girl*rural*76							0.781**	
							(0.056)	
Girl*rural*79						0.793**		
						(0.060)		
Observations	2263	1915	1915	1915	2194	2194	2194	2194
R-squared	0.319	0.312	0.304	0.312	0.398	0.382	0.389	0.394

Each regression also includes a set of controls which uses household and individual characteristics. Sample size differs depending on the instrument we are considering. For example, for first two girls instrument we consider only households with two or more children. Huber-White standard errors in parentheses. **, * , and + denote significant at 1, 5, and 10 percent level, respectively.

Table 4: Second-stage estimates of the effects of children on parental health

	Excluded Instruments in the second-stage					
Health Status	first girl	first two girls	girl*rural*1973	girl*rural*1976	First girl* rural*1979	First two girl* rural*1979
Self-rep. health	0.059	-0.154	0.231**	0.132+	0.186*	0.128+
	(0.206)	(0.212)	(0.066)	(0.070)	(0.075)	(0.068)
ADL	0.005	-0.069*	0.007	0.003	0.022+	0.007
	(0.031)	(0.030)	(0.010)	(0.011)	(0.012)	(0.010)
Mental health	-0.030	-0.057	0.008	0.017	0.024	0.012
	(0.045)	(0.045)	(0.015)	(0.016)	(0.017)	(0.015)
BMI	-0.123	0.000	-0.095	-0.041	-0.099	-0.045
	(0.276)	(0.235)	(0.088)	(0.094)	(0.099)	(0.090)
Blood pressure	-0.479	-0.675*	-0.021	0.057	0.136	-0.001
	(0.292)	(0.299)	(0.092)	(0.099)	(0.107)	(0.095)

Each cell corresponds to a separate regression of health status variable on the fertility (which is instrumented), controlling for household and individual characteristics.
Huber-White standard errors in parentheses. **, * , and + denote significant at 1, 5, and 10 percent level, respectively.

Table 5: Effects of children on mother's and father's health

	Excluded Instruments in the second-stage					
Health Status	first child is a daughter		girl*rural*1973		girl*rural*1979	
	Mothers	Fathers	Mothers	Fathers	Mothers	Fathers
Self-rep. health	0.167	0.007	0.214*	0.253**	0.163	0.215*
	(0.285)	(0.297)	(0.094)	(0.095)	(0.111)	(0.103)
ADL	-0.008	0.022	0.000	0.014	0.025	0.019
	(0.042)	(0.047)	(0.013)	(0.015)	(0.016)	(0.017)
Mental health	-0.003	-0.048	-0.007	0.019	0.007	0.041+
	(0.069)	(0.059)	(0.024)	(0.019)	(0.028)	(0.021)
BMI	-0.409	-0.585	0.070	0.110	-0.097	0.283+
	(0.406)	(0.424)	(0.122)	(0.130)	(0.141)	(0.146)
Blood pressure	0.151	0.077	-0.035	0.009	0.184	0.097
	(0.389)	(0.412)	(0.127)	(0.132)	(0.151)	(0.152)

Each cell corresponds to a separate regression of health status variable on the fertility (which is instrumented), controlling for household and individual characteristics. Huber-White standard errors in parentheses
**, * , and + denote significant at 1, 5, and 10 percent level, respectively.

Table 6: Effects of financial transfer and having adult children living at home, or in close geographical proximity, on health

Health Status			IV Estimates	
Self-reported health	(1)	(2)	(3)	(4)
Living with/near adult child	-0.060	-0.021	-0.015	
	(0.049)	(0.055)	(0.359)	
Amount of Transfer		-0.02963**		-0.02969**
		(0.01083)		(0.0108)
ADL				
Living with/near adult child	-0.000	0.003	0.026	
	(0.007)	(0.008)	(0.056)	
Amount of Transfer		-0.0035**		-0.0041**
		(0.0012)		(0.0013)
Mental health				
Living with/near adult child	-0.025*	-0.012	0.135	
	(0.011)	(0.012)	(0.083)	
Amount of Transfer		-0.0049**		-0.0048**
		(0.0012)		(0.0012)
BMI				
Living with/near adult child	0.220**	0.235**	0.653	
	(0.069)	(0.075)	(0.486)	
Amount of Transfer		0.0033		-0.0012
		(0.0113)		(0.0117)
Blood pressure				
Living with/near adult child	0.103	0.125	-0.634	
	(0.071)	(0.079)	(0.553)	
Amount of Transfer		0.0222*		0.0193+
		(0.019)		(0.0109)
First-stage			Living with/ near adult child	Financial transfer
Child education (IV)			[0.046**]	[-0.336*]
			(0.011)	(0.140)

Regressions also include control for household and individual characteristics. Huber-White standard errors in parentheses. **, * , and + denote significant at 1, 5, and 10 percent level, respectively.

Table 7: Effects of presence of an adult daughter living at home, or in close geographical proximity, on health

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	Self-reported health		ADL		Mental health		BMI		BP	
with/near	-0.052	-0.097*	0.006	-0.001	-0.019+	-0.017	0.078	0.035	-0.010	-0.027
daughter	(0.048)	(0.049)	(0.008)	(0.008)	(0.011)	(0.011)	(0.066)	(0.068)	(0.068)	(0.070)
Number of		0.083**		0.012**		-0.002		0.079**		0.032
children		(0.021)		(0.003)		(0.005)		(0.028)		(0.028)
No. of Obs	2260	2260	2260	2260	2260	2260	1786	1786	1800	1800

Regressions also include control for household and individual characteristics. Huber-White standard errors in parentheses. **, * , and + denote significant at 1, 5, and 10 percent level, respectively.

Figure1: Children and Health Status of Elderly Parents

Figure 1A: Children and Self-reported health Status

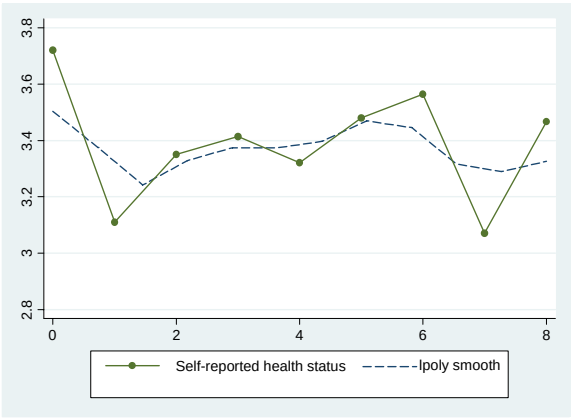

Figure1B: Children and Mental Health

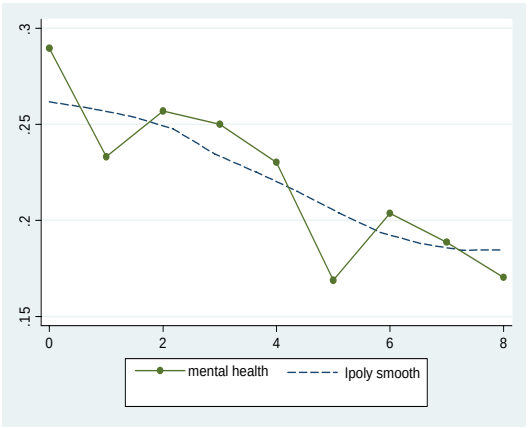

Figure 1C: Children and Activity of Daily Living

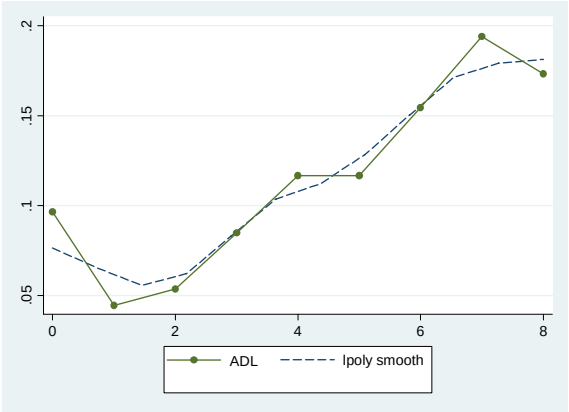

Figure1D: Children and Body Mass Index

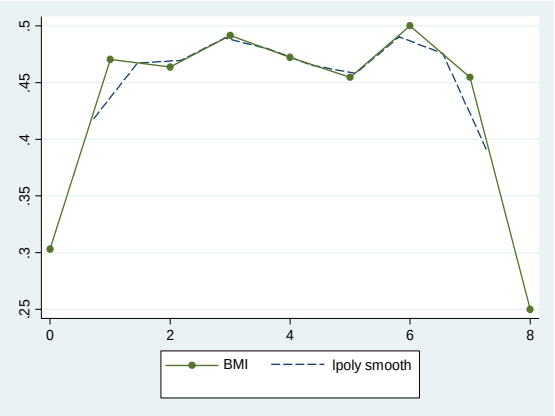

Figure 1E: Children and Blood Pressure