Son Preference and Access to Social Insurance: Evidence from China's Rural Pension Program

AVRAHAM EBENSTEIN
STEVEN LEUNG

IN 1979 the Chinese government instituted the one-child policy in an attempt to slow the growth of China's population. Communist party officials, fearing that rapid population growth would inhibit economic growth and modernization, initiated coercive and restrictive measures to limit fertility (White 2006). While the policy restricted births for both rural and urban residents, the primary intent was to reduce births among rural peasants, who accounted for over two-thirds of the country's population. Although fertility in China, continuing its 1970s decline, fell from 2.96 births per woman in 1981 to (by some estimates) as low as 1.5 births in 2007, one consequence of fertility restriction was a rapid rise in the portion of births that were male. Sex-selective induced abortion became common in the countryside (Zeng et al. 1993; Chu 2001), and the sharpest increases in this practice were observed in areas with the strictest policy enforcement (Ebenstein 2010). Patterns of births indicate that parents in rural China are reluctant to complete their childbearing without having at least one son.

The persistence of son preference in spite of China's modernization is at first surprising, but many scholars point to economic conditions in rural China that make sons valuable to parents. While son preference is in part a religious or cultural value that is unexplained by economic incentives, a large component is the economic value sons provide to parents. This manifests itself through three primary channels. First, sons are arguably more valuable as farmers than are daughters, as they provide higher labor income to parents (Qian 2008).[1] Second, because all land in China is formally owned by the state and because daughters traditionally join the husband's family upon marriage, a son affords parents the opportunity to reap financial benefits from

their land through informal bequest arrangements. Finally, the traditional expectation is that sons care for parents when they are no longer able to care for themselves, and an important motivation for having a son is to secure a viable source of support in old age.[2] This third motivation is the focus of this article. We exploit quasi-random variation in China's 1991 introduction of voluntary old-age pension programs in hundreds of rural villages to examine (1) whether sons and formal savings mechanisms are viewed by parents as substitutes for each other, and, by extension, (2) to what extent the female birth deficit is related to a missing market for social insurance.

Using the 2002 China Household Income Survey (CHIS), which contains detailed information about village pension programs and demographic characteristics, we find that parents without sons are more likely to participate in voluntary old-age pension programs and to have a higher amount of savings specifically intended for old-age support than do parents who have a son. Together, these findings suggest that son preference is in part driven by concerns relating to care in old age. In the second part of our analysis we attempt to answer a potentially more vexing policy question: has the experiment with rural old-age pension programs increased the share of parents willing to terminate their childbearing without producing a son and, consequently, lowered the sex ratio at birth? Using a matched sample of China's county-level 2000 Census and the pension program information in the CHIS, we find that between the program's inception in 1991 and 2000 the sex ratio at birth (males per 100 females) increased more in counties with fewer villages participating in the program. The increase in the sex ratio at birth was 9 percent lower in counties that adopted the program, even after controlling for county-level variation in average education, share employed in agriculture, and other factors affecting the sex ratio at birth. The policy implication is that a further expansion of the pension program may mitigate the effects of the sex ratio distortion.

Sons as providers of old-age support

Son preference is deeply rooted in traditional Chinese culture, and the need to have at least one son is especially strong for both religious and practical reasons. Religious motivations are rooted in the Confucian custom that only a son can perform such tasks as ancestor worship, filial support of elders, and continuation of the family line as patriarch (Milwertz 1997).[3] The persistence of son preference, however, is thought to be related in particular to the son's role in providing support in old age (Das Gupta et al. 2003; Greenhalgh and Winckler 2005). Indeed, over half (51 percent) of respondents to a fertility survey in Hubei province identified the primary motivation for a son as the desire for old-age support, while continuation of the family line (20 percent) placed a distant second (Davin 1985).

The fact that parents in rural China rely on sons rather than daughters for elderly care is perhaps due to the traditionally patrilocal culture (Bray 1997).[4] In patrilocal cultures, daughters are expected to provide care for their in-laws. A son generally provides parents with two caregivers (his bride and himself), while a daughter marries out, leaving her parents with no caregivers (Pasternak 1985). Couples who fail to have a son are in a precarious situation, one that is further brought home to them by frequent government warnings that families in rural areas should not anticipate government old-age support (Lin 1994). Given the traditional role of the son as caregiver, it is unsurprising that the forced reduction in fertility is associated with an increase in the sex ratio at birth in rural areas.

While sons in most parts of rural China provide support to parents in old age, this custom is not universal. Li et al. (2004), analyzing parental support in rural Songzi county in Hubei province, find that sons and daughters provide similar levels of care to parents. They observe that daughters support their natal families financially even in traditional patrilocal marriages where the daughter joins her husband's family, and sons who "marry out" in uxorilocal marriages support their natal families as well. Interestingly, this county has maintained a stable sex ratio at birth in spite of the rigid fertility restrictions imposed on its inhabitants. The authors suggest that Songzi county's diversi-fied marriage forms and weaker son preference may result from a perception that daughters and sons are equivalent in their expected provision of old-age support. The Songzi example suggests that changing patterns in old-age sup-port may reduce the willingness of parents to engage in prenatal sex selection in the face of fertility restrictions. In most of rural China, the role of sons as caregivers is a deeply entrenched custom, but the recent attempts to introduce market-based reforms in rural areas may mitigate son preference.

China's market-based pension programs in rural villages

In 1986, China began to explore alternatives to the traditional family-based old-age support systems in rural areas (Wang 2006).[5] The Rural Old-Age Pension Program[6] was initiated in 1991 under the supervision of the Minis-try of Civil Affairs as an institutional framework for administering a pension program based on voluntary-contribution, defined-contribution, and fully funded individual accounts (Shi 2006). Later that year, the Ministry launched successful pilot programs in five counties in Weihai and Yantai municipalities in Shandong province (Leisering et al. 2002). Within six weeks about 80,000 peasants (92.5 percent of the eligible population) were participating in the pilot programs. Interest in these programs was high, and even villages not chosen for the experiment expressed interest in participating (Zeng 1995). By the end of 1992, the Ministry had expanded the programs to over 1,000

counties, covering most of Jiangsu province. It then began outlining plans for expansion throughout China (Leisering et al. 2002).

Although these insurance programs did not provide a complete social safety net, they allowed individuals to contribute to the pension scheme with tax-exempt earnings and supplemented these contributions with subsidies from employers and local communities (Leisering et al. 2002). Persons aged 20–60 years were eligible to contribute premiums, and the amount of monthly contributions was flexible. If a community collective fund existed, a percentage of the premium could be paid from this source. In addition to being tax-exempt, these pension funds were given a high interest rate and protection against inflation (Zeng 1995). Participation was administered at the city and county level by social insurance agencies. Although participation was not compulsory, the program expanded rapidly and reported 11 billion yuan (about $1.3 billion) in accumulated funds by the beginning of 1997 (Leisering et al. 2002).

Despite the initial success of the pilot rural pension programs and a successful expansion during the early 1990s, however, the growth of these programs stagnated in the late 1990s as both popular and political support declined. Popular support waned amid allegations of poor management (Wang 2006), intimidating recruitment tactics and embezzlement (Shi 2006), and suspicions related to the financial sustainability of the promised returns (Zeng 1995). Furthermore, village administrators in many localities had no incentives to participate, since the administrative costs of the pension schemes were large and were not subsidized by the provincial or national government. In addition to the start-up costs, the programs also incurred an annual operating expense of a hefty 3 percent of total local pension contributions (Leisering et al. 2002).

Political conflict eroded internal support for the programs, as the Ministry of Finance disputed assertions by the Ministry of Civil Affairs and maintained that public provisions for old-age care were unnecessary (Shi 2006). The Asian financial crisis of 1997 may have represented the last straw. Ostensibly, the large decline in asset prices made village leaders wary of placing residents' assets in modern financial vehicles (Leisering et al. 2002), but perhaps more importantly the crisis provided the excuse for de-prioritization and was the impetus for a fundamental change in policy orientation. As the idea that the family should remain the primary provider of old-age support regained popularity, government enthusiasm for the pension program waned[7] (Zeng 2005).

Despite the impediments, the rural pension program still attracted a sizable number of insurants before entering a stage of decline. The size of the Rural Old-Age Pension Program peaked in 1997 with 82.8 million farmer insurants (Shi 2006), but declined to approximately 53.9 million in 2004 (Zeng 2005). The proportion of rural farmers insured under these programs declined from 15.4 percent in 1997 to around 11 percent in 2004 (Wang 2006), and

county-level coverage decreased from 2,100 counties in 1990 to 1,887 counties in 2004 (Zeng 2005). In a recent survey Wang (2006) found that roughly 7 percent of the rural elderly aged 60 and older receive either social old-age insurance or pension benefits, implying that the program has maintained a presence in spite of the difficulties in its implementation.

While participation rates in these programs are reported by aggregate data, very little is known about the patterns of program enrollment. In the next section, we describe the data we use to analyze this enrollment decision. They include micro-level information on program availability, participation, and the number and sex of living children among those who choose to contribute to the rural pension program. We also describe the county-level demographic data from the 2000 Census, which we use to assess whether these programs are associated with a lowering of the sex ratio at birth.

Data

2002 China Household Income Survey

The 2002 China Household Income Survey provides extensive demographic information for individual survey respondents in rural areas, and it is complemented by a village-level survey that collected information on demographic and economic characteristics of villages and their participation in pension programs. The CHIS sample comprises 37,969 individuals in 961 villages across China. Table 1 summarizes the sample means of the villages separately by whether the village participated in the pension program, and the map in Figure 1 shows the geographic coverage of the survey. The villages, selected through multi-stage random sampling, represent six geographic regions and 95 counties in China (Li et al. 2008).

The CHIS individual survey contains detailed information regarding participation in the old-age pension program, individual-level savings for old-age support, and whether the individual lived in a village where the pension program was available.[8] Some 6.7 percent of responding villages report that they sponsored the program for their residents, and 5.4 percent of the respondents report being program participants. The survey also contains information on the number and sex of children in each family surveyed.[9] Because the CHIS is limited in size, the individual information in the survey is combined with county-level data from China's 2000 Census, which provides a more comprehensive assessment of fertility patterns.

China's 2000 Census

To assess the impact of program availability on China's sex ratio at birth, we use a county-level data set for China that contains tabulations of fertil-

TABLE 1   Sample averages for respondents in the 2002 China Household Income Survey according to whether their village sponsored the old-age pension program

Variable	Pension sponsored by village (1)	Pension not actively sponsored (2)	Difference in averages (1) − (2)
Age	35.6	33.1	2.52***
	(4.79)	(4.23)	(0.55)
Male (1=yes)	0.51	0.52	−0.01
	(0.05)	(0.05)	(0.01)
Years of education	6.82	6.61	0.21
	(1.25)	(1.11)	(0.14)
Yearly income per capita (yuan)	1,767	974	793***
	(1,989)	(1,152)	(156)
Days spent planting	110	166	−56***
	(83)	(138)	(17)
Financial assets per household (yuan)	8,837	7,376	1,461
	(10,330)	(8,890)	(1,147)
Savings for old age per household (yuan)	691	664	27
	(2,475)	(2,053)	(312)
Number of sons	0.69	0.81	−0.12***
	(0.27)	(0.29)	(0.04)
Number of daughters	0.61	0.67	−0.06*
	(0.28)	(0.26)	(0.03)
Family has no son (1=yes)	0.37	0.31	0.06**
	(0.22)	(0.19)	(0.02)
Minority (1=yes)	0.05	0.16	−0.11**
	(0.20)	(0.35)	(0.04)
Running water (1=yes)	0.71	0.56	0.15***
	(0.41)	(0.45)	(0.06)
Older than age 40 (1=yes)	0.43	0.38	0.06***
	(0.14)	(0.11)	(0.01)
Pension available (1=yes)	0.19	0.04	0.15***
	(0.29)	(0.15)	(0.02)
Health insurance available (1=yes)	0.02	0.01	0.01
	(0.12)	(0.09)	(0.01)
Poverty relief available (1=yes)	0.24	0.21	0.04
	(0.43)	(0.40)	(0.05)
Number of respondents	2,563	35,406	
Number of villages	66	895	

* Significant at 10%; ** significant at 5%; *** significant at 1%.
NOTES: Standard deviations are given in parentheses in columns 1 and 2. In column 3, we report the difference between the sample averages; standard errors of the differences are given in parentheses. Availability of the rural pension program is taken from the CHIS village survey. 1 yuan = $0.12.
SOURCE: 2002 China Household Income Survey.

FIGURE 1   Location of counties covered by the 2002 China Household Income Survey according to whether the sampled village sponsored the pension program
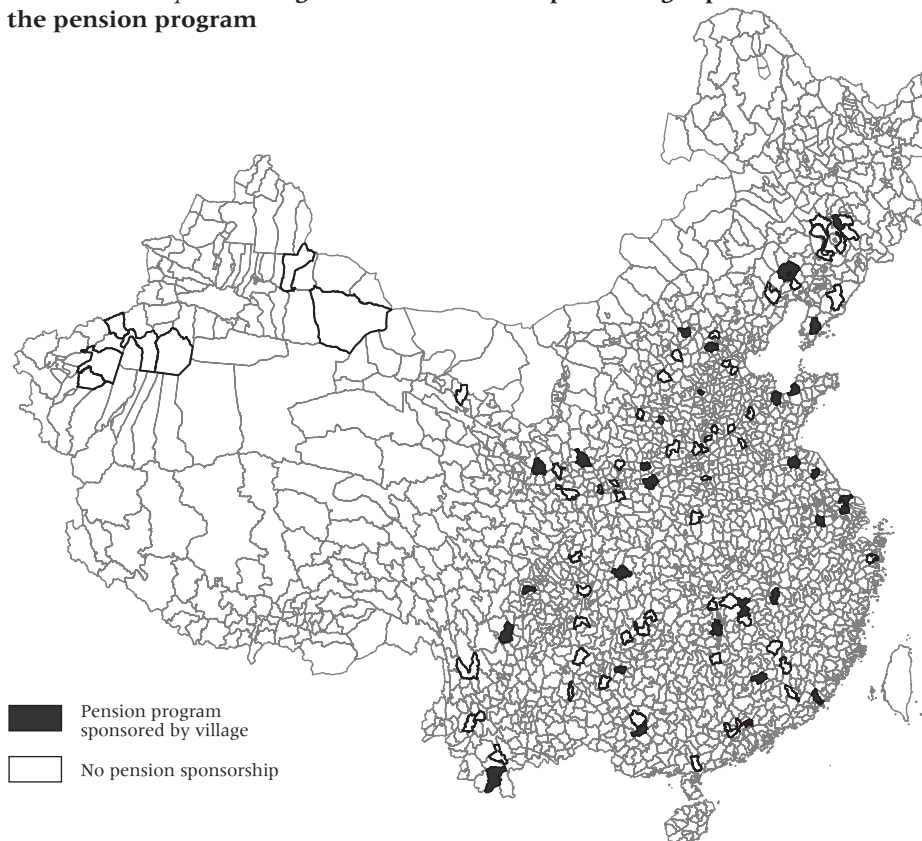
SOURCES: China 2000 Census and 2002 China Household Income Survey.

ity rates and sex ratios by age group for China's 2,873 counties.[10] The CHIS information is provided at the village level and aggregated and matched to the census data at the county level. Table 2 reports the sample averages in the census sample, as well as the averages for the 95 counties that had at least one village surveyed in the CHIS.[11] Figure 2 maps county-level patterns in the sex ratio at age zero to age nine years,[12] which is used as a proxy for the sex ratio at birth. Figure 2 reflects pronounced regional heterogeneity. Sex ratios at birth are particularly high along the southern coast and along the central eastern coast, areas where son preference is known to be intense and where China's fertility regulations are strictly enforced (Gu et al. 2007). In contrast, western provinces such as Tibet, Xinjiang, and Inner Mongolia—all with large populations of mainly policy-exempt ethnic minorities—have less-skewed sex ratios at birth. The spatial heterogeneity in the sex ratio distortions suggests that a county-level analysis of China's

TABLE 2   Sample averages of counties in China's 2000 Census and in counties in the 2002 China Household Income Survey according to whether village sponsored the old-age pension program

| | | Counties covered by CHIS | | |
| | | | | |
Variables	All counties (1)	Counties with pension (2)	Counties without pension (3)	Difference in averages (2) – (3)
Population	432,514	738,406	555,817	182,590**
	(341,254)	(441,920)	(263,581)	(72,595)
Total fertility rate	1.32	1.29	1.46	−0.17*
	(0.47)	(0.36)	(0.52)	(0.10)
Sex ratio (all ages)	104.7	104.3	106.0	−1.79*
	(9.4)	(4.8)	(3.9)	(0.92)
Sex ratio (age 0–9 years)	114.1	114.0	115.3	−1.33
	(10.6)	(10.0)	(11.1)	(2.35)
Sex ratio (age 10–19 years)	107.8	107.4	109.0	−1.64
	(7.7)	(7.3)	(4.8)	(1.25)
Years of education	6.87	6.88	6.67	0.21
	(1.7)	(0.8)	(1.0)	(0.20)
Share in manufacturing	0.11	0.11	0.06	0.04**
	(0.12)	(0.11)	(0.07)	(0.02)
Share in construction	0.027	0.030	0.020	0.01**
	(0.03)	(0.02)	(0.02)	(0.00)
Share older than age 40	0.321	0.339	0.320	0.020*
	(0.05)	(0.06)	(0.04)	(0.01)
Fine rate	1.15	1.80	1.05	0.75***
	(0.85)	(1.27)	(0.92)	(0.23)
Number of countries	2,873	34	61	

* Significant at 10%; ** significant at 5%; *** significant at 1%.
NOTES: Standard deviations are given in parentheses in columns 1, 2, and 3. In column 4 we report the difference between the averages of columns 2 and 3; standard errors are given in parentheses. We define counties covered by the CHIS as those in which at least one village was sampled by the CHIS (N=95). A similar proxy of county-level pension program sponsorship is used; if the CHIS village within a county has sponsored the pension program, the county is classified as having sponsored the program. Further details regarding the implication of these classifications are given in the text and text references. Share urban and share in manufacturing refer to fraction of total employees who are employed in the respective sectors. The fine rate refers to the monetary penalty (measured in years of income) applied to births in violation of the one-child policy. Details regarding the calculation of this variable are available in the text.
SOURCES: China 2000 Census and 2002 China Household Income Survey.

fertility trends may help to identify the factors underlying the increase in the sex ratio at birth. While scholars have raised questions about the reliability of China's census data, these are the best available nationwide measures of China's recent fertility experience.[13] These sex ratio distortions are explored further in a later section.

FIGURE 2   Sex ratio for age group 0–9 years, by county, in China's 2000 Census

Sex ratio

- 89–105
- 106–108
- 109–113
- 114–123
- 124–169
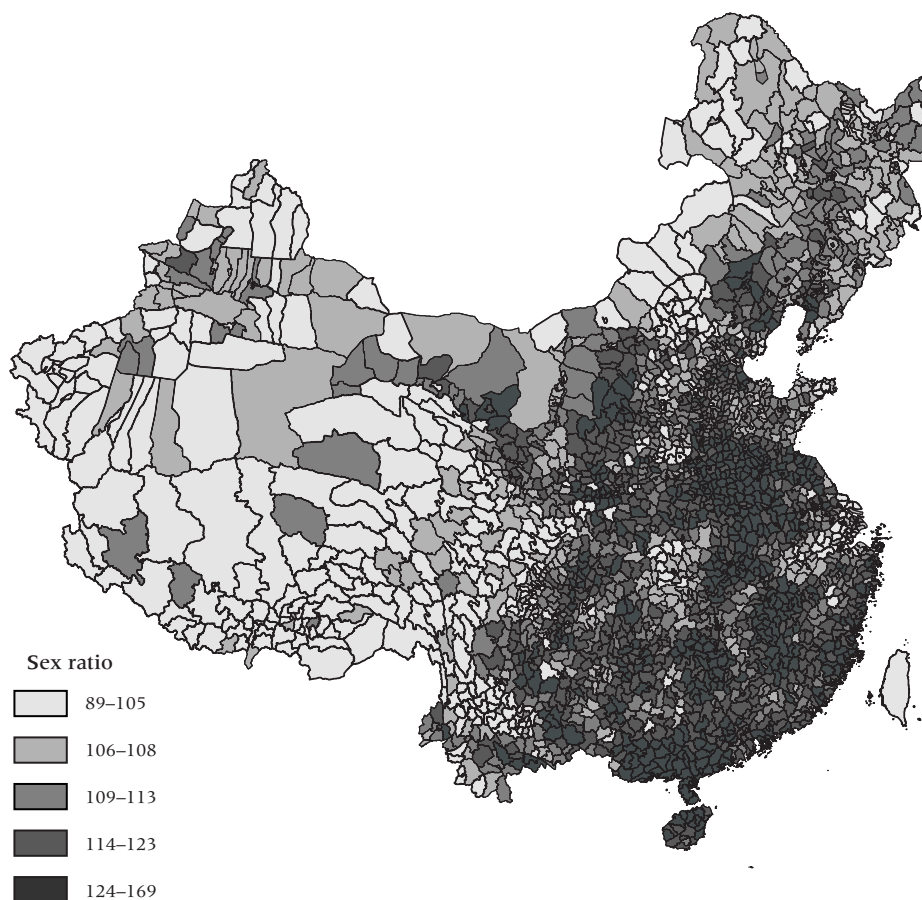
SOURCE: China 2000 Census.

Family sex composition and preparation for old age

Next we explore the relationship between the number and sex of a family's children and financial preparations for old age. Survey respondents in the CHIS who were not currently enrolled in the rural pension program were asked whether they would be interested in participating in the future. Over 50 percent of respondents expressed a desire to participate in the future, suggesting that the pension program falls far short of meeting demand. Figure 3a reflects the strong link between family sex composition and a respondent's interest in participating in a pension program. Among parents with one or two children, those with only sons or only daughters appear to have a similar level of interest in program participation. However, parents with three or four

FIGURE 3a   Parents' interest in participating in the old-age pension program according to number and sex of children
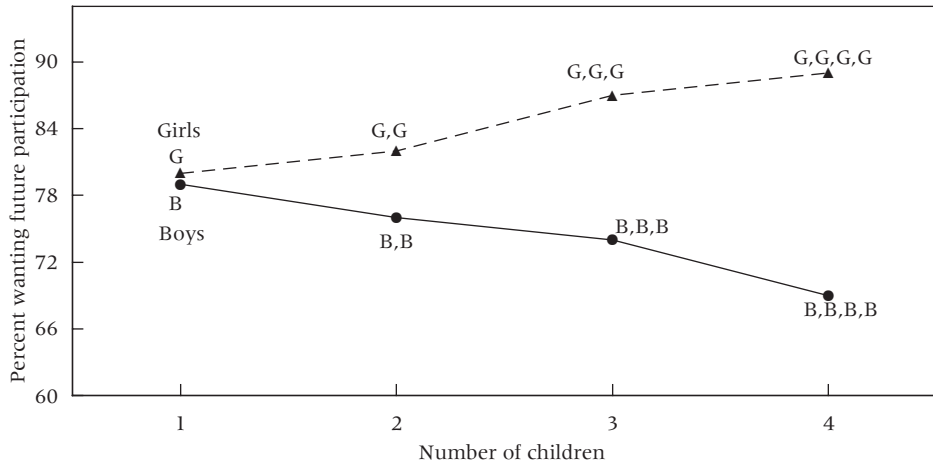
NOTES: Figure excludes couples with both sons and daughters.
SOURCE: China 2002 Household Income Survey.

daughters are far more likely to express interest in future participation than those with three or four sons. Among parents with three or four daughters, 87 percent and 89 percent express interest in participating in the future, compared with 74 percent and 69 percent of those with three or four sons.

FIGURE 3b   Parents' interest in participating in the old-age pension program: Family composition that includes a son versus having another daughter
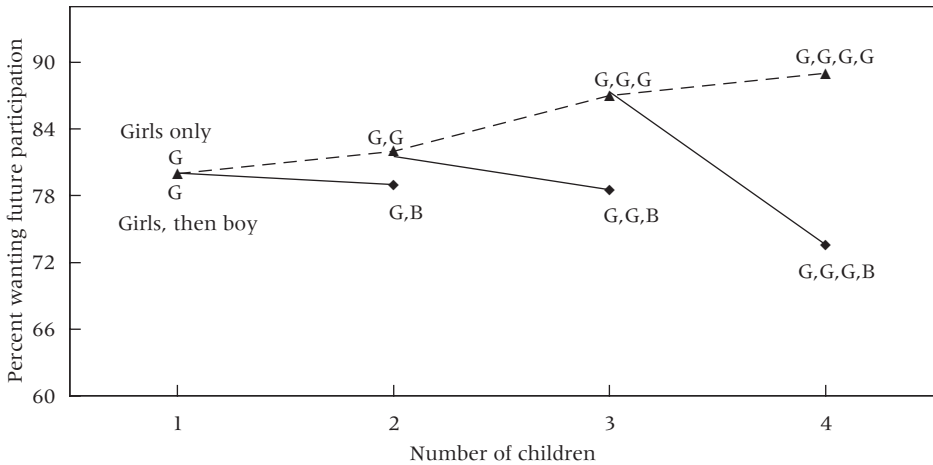
NOTE: Figure excludes all other fertility outcomes.
SOURCE: China 2002 Household Income Survey

Figure 3b reflects the impact of achieving a family composition that includes a son, versus the alternative of having an additional daughter. Of particular interest are the differences in desire to participate in the pension program between parents who have had three daughters (87 percent wish to participate) and those who have had two daughters and then a son (78 percent), or between parents who have had four daughters (89 percent) and those who have had three daughters and a son (73 percent). Together, Figures 3a and 3b suggest that parents anticipate more care and provision from sons, a hypothesis we explore more rigorously in the next section.[14]

Pension program participation and family sex composition

Our results demonstrate that household participation rates in China's rural pension program are higher among families with fewer children and, in particular, among families with no sons. To examine the relationship between program participation and a couple's family sex composition, we estimate regressions to examine the factors correlated with a binary (0/1) variable indicating participation using ordinary least squares (OLS). In the first set of specifications, we estimate the effect of a binary variable for failure to have a son (*noson*) on a binary variable for participation in the rural old-age pension program (*participation*) and a set of covariates (*x*) that may also predict participation:

$$participation_i = \alpha + \beta_1(noson_i) + X_i\beta + \varepsilon_i,$$

where the subscript i denotes ..., α is a constant, β_1 and $\beta = (\beta_2, ...)$ are coefficients, and ε is an error term.

The estimates of a simplified specification with no control variables are reported in column 1 of Table 3. Parents who fail to have a son are 1.1 percentage points more likely to participate in the program, which implies that relative to an overall participation rate of 3.9 percent in this sample,[15] they are roughly 28 percent more likely to participate. In a second specification, we add explanatory observable family characteristics such as household income measured in yuan, annual hours spent in agriculture (as a proxy for unreported household agricultural output), financial assets, the mother's age and age squared, and the mother's educational attainment measured in years of education. The results are reported in column 2 of Table 3, with the coefficients on the controls suppressed. Again, the results indicate that failing to produce a son increases the likelihood of participating, in this case by 1.4 percentage points. The R squared levels are .001 and .038 in the two models, indicating that pension participation is influenced by many factors other than the regressors included in the model, such as risk aversion.

TABLE 3   Relationship between family sex composition and pension enrollment

Variable	Participation in pension program					
	(1)	(2)	(3)	(4)	(5)	(6)
No sons	0.0114***	0.0138***			0.0199***	0.0186***
	(0.004)	(0.004)			(0.007)	(0.007)
Number of sons			−0.0186***	−0.0247***		
			(0.003)	(0.003)		
Number of daughters			−0.0152***	−0.0221***		
			(0.002)	(0.003)		
Controls	No	Yes	No	Yes	Yes	Yes
Restricted sample	No	No	No	No	Yes	Yes
Mean participation rate	0.039	0.039	0.039	0.039	0.038	0.038
Observations	11,453	11,057	11,453	11,057	3,811	3,601
R^2	0.001	0.038	0.004	0.044	0.003	0.044

* Significant at 10%; ** significant at 5%; *** significant at 1%.
NOTES: Robust standard errors in parentheses. Suppressed controls included are age, age squared, years of education, total household income, total days spent planting in the previous year, and total financial assets. Sample consists of all household heads in the CHIS and their matched children less than 20 years of age. Restricted sample includes only households in which the eldest child is at least 11 years of age and thus was born prior to initiation of the rural pension program (1991).
SOURCE: 2002 China Household Income Survey.

The third and fourth specifications examine the impact of the total number of sons and daughters on the probability of participation. Specification 3 estimates the effect of additional numbers of sons and daughters on parents' pension participation:

$$participation_i = \alpha + \beta_1(sons_i) + \beta_2(daughters_i) + X_i\beta + \varepsilon_i,$$

where $\beta = (\beta_3, ...)$.

The results of the specification, shown in column 3 of Table 3, indicate that each additional son reduces the probability of participation by 1.9 percentage points, whereas an additional daughter reduces the probability by 1.5 percentage points. A fourth specification includes the controls that were added in specification 2 and estimates the coefficients on sons and daughters with the addition of observable family characteristics. With the added family characteristics as controls, the coefficients on additional sons and daughters remain negative, but their magnitudes are larger. We find that an additional son decreases the probability of participation by 2.5 percentage points, whereas an additional daughter decreases the probability by 2.2 percentage points. Therefore, sons appear to have a larger impact on the probability of participation, consistent with an interpretation that parents view the anticipated value of a son to be greater than the value of a daughter as nonmarket old-age insurance.

A potential weakness of this analytic approach is reverse causality: families with sons may have engaged in sex selection, and their decision to do so may have been affected by program availability. To address this weakness in the identification strategy and as an additional robustness check, we examine whether couples who completed their first fertility decision before the introduction of the program exhibit patterns similar to those of other parents. We restrict the regression sample to those mothers whose first child was at least 11 years old at the time of the survey: that is, those born before the 1991 pilot date of rural pension programs. The regression results using the restricted sample, reported in columns 5 and 6, produce coefficients similar in magnitude to those using the full sample shown in columns 1 and 2.

The finding that family sex composition affects program participation is depicted in Figure 4, which indicates that families with one child are more likely to participate and that, among families with two children, those with two daughters are more likely to participate. Families who have an only daughter are more likely to participate than those who have an only son. Notably, the figure depicts participation in a clear three-tiered pattern, where parents with two sons are less likely to participate than those with a mixed-sex two-child family, who are in turn less likely to participate than parents with two daughters or those with only one child.

Although we find a striking relationship between a family's sex composition and the decision to participate in the pension program, this cannot be interpreted as the causal impact of family sex composition on the probability of program participation. First, program participation is partly influenced by access to the program, and villages with stricter fertility regulations (and

FIGURE 4   Percent of parents participating in the old-age pension program by sex composition of family
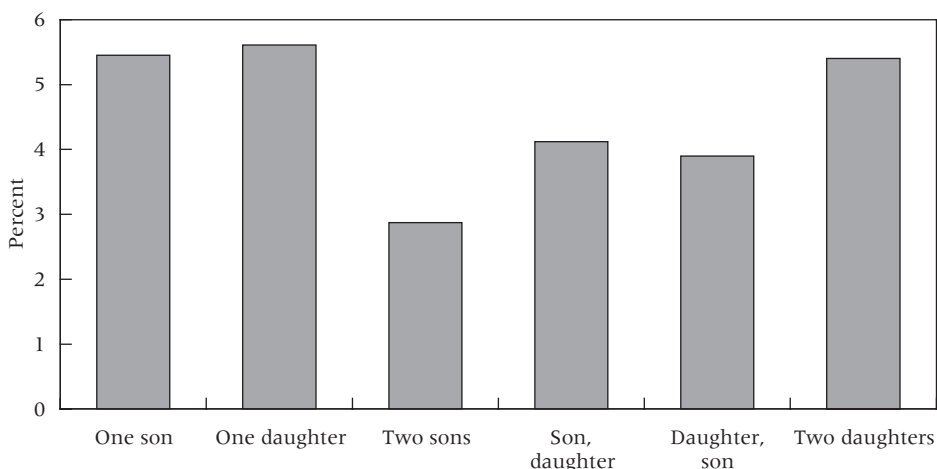
SOURCE: 2002 China Household Income Survey.

consequently lower fertility rates) may have been more likely to adopt the program. Note, however, that this possible objection does not discredit our core hypothesis, since it is consistent with the claim that sex composition affects a couple's perceived need for financial resources in old age. A second challenge to interpreting these regressions is that parents with a more modern attitude toward formal savings programs (such as the pension program) may also desire fewer children and be less concerned about having a son. Therefore, the results in this section suggest that children, and sons in particular, provide a form of old-age insurance to parents.

Family sex composition and savings for old age

We next demonstrate that a family's savings for old age are higher among families with fewer children and, in particular, among families with no sons. We examine whether saving for old age is responsive to the number and sex of a couple's children. In our first set of models, we estimate the effect of having no sons on the logarithm of savings (*oldsave*), with and without the set of added controls, using ordinary least squares:

$$oldsave_i = \alpha + \beta_1(noson_i) + X_i\beta + \varepsilon_i.$$

The results of these regressions are listed in columns 1 and 2 of Table 4. They suggest that failure to produce a son leads to an increase of 313 yuan

TABLE 4 Relationship between family sex composition and savings for old age

Variable	Savings for old age			
	(1)	(2)	(3)	(4)
No sons	313**	172		
	(159)	(164)		
Number of sons			−278***	−177**
			(83)	(82)
Number of daughters			−207***	−165**
			(76)	(76)
Controls	No	Yes	No	Yes
Average savings (yuan)	551	547	551	547
Observations	5,525	5,341	5,525	5,341
R^2	0.001	0.009	0.002	0.009

* Significant at 10%; ** significant at 5%; *** significant at 1%.
NOTES: Robust standard errors in parentheses. Suppressed controls included are age, age squared, years of education, total household income, total days spent planting in the previous year, and total financial assets. Sample restricted to households in which the household head is at least 25 years of age.
SOURCE: 2002 China Household Income Survey.

in the value of parents' accumulated financial savings for old age. Relative to an average savings level of 551 yuan, this represents a 60 percent increase in savings targeted for old age. Controlling for observable family characteristics, failure to produce a son leads to an increase of 172 yuan, or 17 percent, in savings for old age, although the result is no longer statistically significant. As we found in the results on pension participation, we observe very low R squared levels, less than .01 in both models. This indicates that many factors affecting savings decisions are not captured by the variables we are able to observe in the data. For example, parental savings decisions may be influenced by access to informal sources of old-age support, such as the presence of nearby kin.

Specifications 3 and 4 examine the impact of number of daughters and number of sons on log savings for old age, with and without additional controls for age, income, and financial assets:

$$oldsave_i = \alpha + \beta_2(sons_i) + \beta_3(daughters_i) + X_i\beta + \varepsilon_i,$$

where $\beta = (\beta_3, ...)$.

As shown in column 3, each son is associated with 278 yuan less than average in savings, and each daughter with 207 yuan less than average. These results are slightly smaller in the specifications controlling for the observable features of the parents, with each son reducing savings by 177 yuan and each daughter by 165 yuan compared to average levels. These results are statistically significant and, importantly, include controls for the household's total financial wealth. The results therefore suggest that old-age savings are related to the family's sex composition. The magnitude of the reduction in savings induced by additional sons is significantly larger than the magnitude of the daughter-induced reduction, consistent with an interpretation that children act as a potential substitute for financial savings, with sons providing greater value.

The results indicate that sex composition is clearly related to parents' decisions to prepare for old age, both in the form of participation in pension programs and in setting aside funds for old age. Fertility outcomes that either include daughters or lack sons induce increased old-age preparation, whereas having a son tends to reduce other forms of old-age support. It could be that parents who desire larger families are more traditional and are more skeptical about financial savings in general, and an unobserved correlation between preference for larger family size and a general distrust of formal savings institutions would also generate the negative correlation between savings and family size. The China Household Income Survey allows us to control for a household's total financial assets, so the results indicate that sex composition affects program participation and savings for old age, even when information on the household's full financial assets is included as a regressor.

Rural old-age pension insurance and the sex ratio at birth

We present evidence that the increase in China's sex ratio at birth was mitigated in areas where the Rural Old-Age Pension Program was more widely available. China's 2000 Census offers evidence for a remarkable nationwide increase in the sex ratio at birth during the 1990s, potentially owing to the effects of rigid enforcement of the one-child policy on parents who wished to have at least one son. The introduction of the old-age pension program in 1991 represents a natural experiment that provides variation within China, allowing us to examine whether areas sponsoring the program had a more muted increase in the sex ratio at birth (proxied by the population sex ratio for young age groups). By comparing the sex ratios of survivors in 2000 of births within each county that occurred before the introduction of the program (the birth cohorts of 1981 to 1990) with the sex ratios of survivors of births following the introduction of the program (the birth cohorts of 1991 to 2000), we examine the impact of the program.[16] We first describe overall patterns in the increase in the sex ratio at birth, which suggest that county-level incentives may play a role in this phenomenon; we then present the main empirical results, which indicate that program availability mitigated the increase in the sex ratio at birth.

To examine the effects of pension program availability on sex ratio changes, we estimate a "first-difference" regression on counties from which villages have been sampled in the CHIS. We use the aggregated average of village-level availability, weighted by village population, as a measure of county-level program availability. The participation rate of CHIS villages within a county is our measure of the program's availability within the county. As a dependent variable, we compute the percent change in pre- and post-program sex ratios. The estimation strategy takes the following form, where the change in the sex ratio at birth ($\Delta sexratio$)is a function of a county's sponsorship of a pension program (*oldavail*) and a rich set of control variables—among them, availability of health insurance (*healthavail*) and availability of poverty relief (*povavail*):

$$\Delta sexratio_i = \alpha + \beta_1(oldavail_i) + \beta_2(healthavail_i) + \beta_3(povavail_i) + X_i\beta + \varepsilon_i,$$

where $\beta = (\beta_4, ...)$. The change in sex ratio at birth between pre- and post-program availability is proxied by the differences in sex ratio between the two adjacent decadal birth cohorts:

$$\Delta sexratio_i = \frac{sexratio_{post} - sexratio_{pre}}{sexratio_{post}} = \frac{sexratio_{0to9} - sexratio_{10to19}}{sexratio_{0to9}}.$$

The results of our base specification examining the effect of the rural old-age pension program are reported in column 1 of Table 5. They indicate

that relative to a county with no pension program available, a county in which all villages participate has a 10 percent smaller increase in the sex ratio relative to the average increase. As a measure of context, the average county in the sample recorded a 5 percent increase in the sex ratio during the period, implying a very large projected impact of the program. This regression includes the above-listed controls, as well as additional controls for educational attainment, village income, share of village households that are Communist cadre households (as a measure of voluntary adherence to fertility restrictions), regressors for the proportion of total laborers employed in the construction and manufacturing sectors at the county level (as proxies for urban development), and explanatory variables for total fertility rate and log of the fine rate for a child born in violation of the one-child policy.[17] In column 2, we include regressors for average number of villages that sponsor health insurance programs and number of villages that offer poverty relief programs. Controlling for other county-level attributes, an increase in county-level pension program availability is associated with a slower increase in the sex ratio at birth from pre-program to post-program: we estimate that relative

TABLE 5 Relationship between availability of pension and other programs and change in county sex ratio

Variable	Percent change in sex ratio			
	(1) OLS	(2) OLS	(3) IV	(4) IV
Pension available	−0.099***	−0.087**	−0.721	−0.679*
	(0.03)	(0.04)	(0.43)	(0.35)
Health insurance available		−0.032		−0.007
		(0.04)		(0.01)
Poverty relief available		−0.04		0.023
		(0.03)		(0.07)
Total fertility rate	−0.032	−0.035	−0.079*	−0.076**
	(0.04)	(0.03)	(0.04)	(0.03)
Log fine rate	0.024	0.024*	0.036*	0.035*
	(0.01)	(0.01)	(0.02)	(0.02)
Controls	Yes	Yes	Yes	Yes
Observations	95	95	95	95

* Significant at 10%; ** significant at 5%; *** significant at 1%.
NOTES: Robust standard errors in parentheses. The percent change in the sex ratio is calculated as the percent change of the county sex ratio between age groups 0–9 and 10–19. Pension, health insurance, and poverty relief availability are measured as the fraction of villages in each county sampled in the CHIS that provide the listed social program, weighted by the population of each village. The fine rate is the penalty for births in violation of China's one-child policy (see note to Table 2 and endnote 17). Suppressed controls are the county's share of employment in construction, manufacturing, and the average years of education of inhabitants. The OLS (ordinary least squares) regressions in columns 1 and 2 assess the relationship between the share of villages participating in the pension program and the percent change in the sex ratio. The IV (instrumental variable) regressions in columns 3 and 4 use the fraction of county inhabitants over 40 years of age as an instrument for the county's share of villages participating in the pension program. Results of the first-stage regression are described in text.
SOURCES: China 2000 Census and 2002 China Household Income Survey.

to no village sponsorship, full village sponsorship is associated with a 9 percent lower increase in the sex ratio at birth. This can be interpreted relative to an average increase in the sex ratio at birth in these counties of roughly 5 percent, implying that had half the villages in a county adopted the program, the increase would only be 1 percent (on average). The results presented suggest that pension program availability is associated with a negative change in the sex ratio (fewer missing girls). The regression results also suggest that fertility restrictions increase the fraction of births that are male. The fine rate in the county applied to unauthorized births is positively associated with changes in the sex ratio, whereas the total fertility rate is negatively associated with changes in the sex ratio. While many factors determine a county's sex ratio at birth, the counties that provided access to the pension program had less pronounced increases in the sex ratio at birth.

There are several caveats in interpreting these regression results as the causal impact of the availability of the pension scheme on the sex ratio at birth. One limitation is that promotion of the pension program was entrusted to village-level administrators, who may have responded to the needs of the village inhabitants. For example, village decisions to sponsor the program could be related to the dissatisfaction of parents with the sex composition of their families under the strict limitations imposed by the one-child policy. However, the availability of the program is almost certainly driven by the phased introduction of the program, and must be at least partially independent of specific decisions of village-level administrators. It is also unlikely that village elders would acquiesce to demands of village inhabitants if it were economically unfeasible or impossible for them to sponsor such programs in their village. As such, program promotion or lack thereof in 2002 is most likely not influenced by village patterns in fertility. Note also that if parents are indeed demanding the program in response to undesired family sex composition, this reinforces our central claim that the sex ratio may be partly driven by fears regarding care in old age.

A more likely explanation is that villages vary in their ability to successfully implement a structured and self-funded pension program, and the villages that sponsored the program are likely to be better off in other ways as well. As reflected in Table 1, villages sponsoring the program are more likely to have running water and health insurance programs, and have somewhat older populations. Because village promotion of the pension program is voluntary, there are few obvious instruments for program promotion. However, one factor that appears to have affected a village's (or county's) promotion of the program was the proportion of the population aged 40 or older, who would have the greatest interest in participating in such a program. As shown in Table 2, counties sponsoring the program are slightly older on average than those that do not participate: the proportion of the population older than age 40 is 34 percent in counties with the pension program, compared with 32

percent in counties without the program. While the primary conditions used by village leaders to determine whether to sponsor the program are related to the ability of the population to pay the premium, the data indicate that counties with older populations had modestly higher participation rates.[18] This may be due to economies of scale in program implementation, which makes the program more attractive if more individuals are eligible to contribute. Administrative fees still account for a sizable fraction of contributions, implying that scale issues could be important in predicting participation in the program by any particular individual (Leisering et al. 2002). Having more elderly persons in a county may provide variation in the benefits to program participation in a way that would presumably not be correlated with the county's sex ratio.

In Table 5, columns 3 and 4, we use this variation in program attractiveness to produce two-stage least squares estimates of the program's impact on the county's percent change in the sex ratio at birth. The first-stage relationship (not shown) between the share of the county's population over age 40 is a statistically significant predictor of pension availability, with a 1 percent increase in the share over age 40 associated with a 1 percent increase in the participation rate of villages in the county.[19] The instrumental variable (IV) estimates of the pension program's impact on the percent change in the sex ratio are much larger and less precisely estimated than the OLS estimates shown in columns 1 and 2. In the specification without control variables (column 3), we estimate that a 1 percent increase in the county's provision of the program is associated with a 0.72 percent smaller increase in the sex ratio at birth, indicating that counties with the program were less likely to see large rises in the sex ratio. Adding controls lowers the estimate slightly: thus, a 1 percent increase in the village participation rate in the county is associated with a 0.68 percent lower change in the sex ratio at birth. While the IV results are of lower power and have large standard errors, they are consistent with the claim that exogenous variation in the availability (or attractiveness) of the pension program is associated with a smaller increase in the sex ratio at birth. This is presumably because some parents abstain from sex-selective abortion as a result of a reduced need for old-age support. Note this instrument is not ideal, since age distribution in the county is by definition partly correlated with the county fertility rate. Fertility rates are correlated with other unobserved features of a village. We do, however, control for the separate effect of the county's total fertility rate to attempt to address this issue.[20]

In the absence of randomized pension program availability, it is difficult to conclude with certainty that the negative relationship between program availability and the increase in the sex ratio is causal in nature. In combination with the OLS results and the results from the earlier section regarding parental interest in the program and its relation to whether parents had a son, the evidence suggests that expanding social insurance may be a useful strategy for reducing parents' need to have a son for old-age support, and

consequently may be instrumental in reducing the prevalence of sex-selective abortion.

Conclusion

Although rapid industrialization and large declines in fertility have reshaped China in the last 40 years, son preference has survived the transition. The 2005 national-level sex ratio at birth, by an official estimate, reached 118 boys for every 100 girls,[21] possibly related to stricter enforcement of the one-child policy in recent years. The Chinese government has both re-affirmed the one-child limit and declared that reducing the sex ratio at birth by 2016 is a national priority (Li 2007). Such goals may be in conflict with each other if economic conditions making sons valuable to parents are not addressed. We find that parents who fail to produce a son are more likely to participate in old-age pension programs and that the number of children in a family is negatively related to pension program participation. We also find evidence that the rural old-age pension program mitigated the increase in the sex ratio in the areas where the program was available.

Policymakers should be more realistic about the current role of sons as the primary form of old-age care. Even if the one-child policy is unchanged, policymakers could at least seek to provide parents with alternative means to support themselves in old age. At the World Economic Forum's Annual Meeting of New Champions, held in September 2009, Chinese Premier Wen Jiabao stated that China's economic stimulus package includes a trial old-age pension program, covering 10 percent of counties and 90 million people. However, it is far too soon to evaluate the results of this trial, and debates over old-age pension programs in China continue.

As this and other social insurance programs are considered, policymakers should remain aware of the benefits of large-scale pension schemes that allow less-advantaged families to participate. Consolidation and support by the central government could improve participation rates and lower administrative costs relative to contributions. This suggests that new programs may be more successful than those in the past, as they may be more attractive to rural families, provide a market alternative for social insurance, and help parents cope with new norms of family size and less familial support during old age. With more alternatives to sons as providers of old-age support, parents may feel less compelled to have a son, and the sex ratios in China may drop to more normal levels.

Notes

The authors thank Christine Percheski, Jonathan Gruber, Nancy Hearst, Ronald Lee, Sanny Liao, Alison Flamm, Jonathan Pohl, Michael Leung, Jonathan Schlesinger, and Deng Quheng.

1 Qian (2008) analyzes variations in regional and sex-specific incomes in China and finds that higher relative income for females mitigates the distortion in the sex ratio at birth.

2 Cameron and Cobb-Clark (2001) note that provision of care in old age is an important motivation for having a son in many other developing countries as well.

3 A notable passage from Confucius' Analects regarding filial piety reports him as stating, "If there is work to be done, young people shoulder the burden, and when wine and food are served, elders are given precedence" (Confucius, Analects 2.8).

4 Traditional kinship in China is determined according to rules of patrilineal descent. The closest bonds are those traced along the lines of male descent, and relatives on the mother's or wife's side were considered more distant relatives. In some areas, it was even customary to enforce restrictions on visits between a wife and her natal family (Bray 1997).

5 Whereas consistently growing urban old-age security systems have been in place since 1951, as part of the nation building and socialist rhetoric of the Maoist era, old-age programs have been largely inaccessible to rural areas. Access to any old-age security program is further limited by the extremely rigid urban/rural *hukou* registration system that prevents rural residents from reregistering as urban residents.

6 Although a direct translation of the program would be "insurance," we opt here to refer to the program as a pension, a term that most Western scholars have used when referring to the program because of its more precise representation of the program's function. It may have been a deliberate gesture by the Ministry of Civil Affairs to include the term insurance when naming the program (the title is directly translatable as Rural (Farm) Old-Age Insurance, and it avoids the word for "retirement pension"). Interestingly, some villages intentionally propagandized the programs as "insurance" to tempt pensioners into believing that a larger element of government protection was involved (Leisering et al. 2002).

7 Zeng (2005) suggests other practical challenges facing pension program implementation. One suggested logistical challenge was the difficulty of maintaining a pay-as-you-go pension scheme in the face of the migration patterns that sent young people to urban areas while the elderly remained in rural areas. A second challenge suggested by Zeng is the misalignment among government organizations, meaning that the goals of the rural old-age pension program were not clearly communicated to local family planning officials.

8 Availability of the program is reported by the party branch secretary, the head of the village committee, or the village accountant.

9 The IPUMS-Minnesota matching rules for assigning children to mothers are used. Information on the IPUMS algorithm is available at «http://www.ipums.umn.edu».

10 The analysis is based on data provided by the Harvard Geospatial Library using both the China 2000 Census Historical data and the China 2000 9.5 percent Long Form data.

11 One anonymous referee noted the potentially problematic designation of counties as "sponsors of the rural pension program" based on the criterion of containing at least one village that has sponsored the program—particularly in light of using of this designation to determine differences in sample means in Table 2. We acknowledge that this designation is first conditional on having been sampled in CHIS, but note that this precondition has little inherent adverse impact on the inferences drawn from Table 2 because of the above-mentioned multi-stage random sampling of the survey. We further acknowledge the limitations of using this binary criterion of "containing at least one village sponsor," because it does not accurately address how the extent of pension sponsorship affects the difference-in-means in the sub-sample of CHIS counties. However, because of the limited

information on county-level availability, we use this rough village-level extrapolation for the purpose of providing an overview, and in later analysis use more rigorous derivations of county-level coverage.

12 Although more precise measures for the sex ratio at birth are available, we choose to depict the sex ratio of this birth cohort as a proxy because of its use in later analyses.

13 Researchers have cautioned that Chinese census data following stricter enforcement of the one-child policy may not accurately reflect the number of females in the population. Mothers who give birth to a daughter and subsequently give birth to a son may choose to hide the earlier female birth in census responses. Banister (2004) finds that the deficit of daughters is real: the high sex ratios in China's demographic data are approximately true, not merely an artifact of faulty data. Cai and Lavely (2003) confirm this finding, suggesting that 71 percent of the missing girls in the 1990 Census are still "missing" in the 2000 Census. Because we are unaware of any measures regarding the geographic variation in under-reporting of daughters, we make no adjustment to the data. If pension availability is not systematically correlated with under-reporting, our main conclusions will not be compromised by problems regarding data reliability. In light of these issues of data reliability, however, our results should be interpreted with caution.

14 An alternative hypothesis is that the birth of multiple sons in China is often deemed expensive because of bequest expectations, and only wealthier families could afford more sons. A family with many sons has a greater number of inheritors and requires a larger accumulation of wealth. As such, mothers with four sons may be wealthy enough not to demand separate old-age support. (Only 5.6 percent of households in the CHIS sample have four or more children.) Wolf (1985) suggests that historically, the fertility of families with greater accumulated wealth (he specifically mentions farm size) has been higher than that of less wealthy families. This alternate hypothesis informs our decision to control for household income, total financial assets, and household agricultural output in the following analyses.

15 The regressions are estimated among the matched sample of parents and children, restricted to households where the oldest child is less than 20 years old. The pension acceptance rate is slightly lower in this sample than in the overall sample (3.9 percent versus 5.4 percent).

16 Differential mortality rates by age and sex may potentially bias the sex ratio of the earlier birth cohort. Banister and Hill (2004) find that mortality rates for males and females in China from ages 5 to 19 years tend to be similar, suggesting that mortality did not have a large impact on the sex ratio at birth for the 1981 to 1990 birth cohort.

17 The fine rates are taken from Scharping (2003) with an imputation as performed by Ebenstein (2010). The code for the fine imputation, as well as a detailed explanation of the calculation of the fine rate, is available on Ebenstein's website: «http://pluto.mscc. huji.ac.il/~ebenstein/».

18 An anonymous referee noted that the decision as to which counties would implement the program was mainly based on the provincial government's judgment "whether the conditions are met," which generally related to the ability of residents to pay the required premiums. In the absence of detailed information regarding this process, we use the crude measure of the county age distribution to predict sponsorship of the program.

19 The results of the first-stage regression are available from Ebenstein upon request.

20 One anonymous referee noted that the chosen instrument might not satisfy the exclusion restriction, since having an older population may directly affect the change in the sex ratio. While this is a valid concern, the data indicate that the instrument (share of county population older than age 40) is not directly correlated with the sex ratio among those aged 0–11 years, the sex ratio among those aged 12–23 years, and other features of the county (e.g., share employed in manufacturing). However, the results should be interpreted with caution since the age composition of a county may reflect other factors not properly accounted for in our estimation strategy.

21 Report issued by Chinese State Council and Central Committee (January 2007).

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