Population Policies, Demographic Structural Changes, and the Chinese Household Saving Puzzle[†]

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September 16, 2017

[†]We would like to thank the editors of European Economic Review and two anonymous referees for their valuable comments and suggestions. We would also like to acknowledge the financial support of the *AdvanceVT* micro-grant from Virginia Tech. Contact information: Ge, Department of Economics, Virginia Tech, Email: ges@vt.edu; Yang, Darden School of Business, University of Virginia, Email: yangd@darden.virginia.edu; Zhang, Department of Economics, Chinese University of Hong Kong, Email: jszhang@cuhk.edu.hk.

Abstract

Using combined data from population censuses and Urban Household Surveys, we study the effects of demographic structural changes on the rise of household savings in China. Variations in fines across provinces for unauthorized births under the one-child policy and in cohort-specific fertility influenced by the implementation of population control policies are exploited to facilitate identification. We find evidence that older households with fewer adult children saved more, middle-aged households with fewer dependent children experienced increase in savings, and younger households with fewer siblings also saved more. These findings lend support to a simple economic model in which the effects of population control policies are investigated in the context of household saving decisions in China.

Keywords: household saving, one-child policy, demographic structure, cohort analysis, China

JEL code: E21, J11, J13

1 Introduction

Household saving rates have increased dramatically over the past two decades in China, rising from 16.1% in 1990 to 21.5% in 2005 (see Table 1). In addition to the rise in average saving rate, the age-saving profile has also evolved into an unusual pattern. In the early 1990s, saving rate for young families was relatively low, and increased with the age of household heads until they were close to retirement. In recent years, however, household age-saving profiles have turned into a U-shaped pattern, with younger and older households having relatively higher saving rates (see Figure 1A). A more pronounced U-shaped increase in age-specific saving rates is observed from 1990 to 2005 (see Figure 1B), as both younger and older households raised their saving rates by over 10 percentage points, much more than middle-aged households.[1] According to the life cycle theory, young workers save little in anticipation of higher future income; the saving rates of middle-aged workers are the highest during peak earning periods; and saving rates plateau or even decline as workers approach retirement. Such a "hump-shaped" life cycle pattern is often observed in typical cross-sectional analyses in other economies (e.g., Attanasio, 1998; Jappelli and Modigliani, 2005). Recent studies explaining the puzzling U-shaped pattern in China have focused on factors such as the rising private burden of expenditures on housing, education, and health care (Chamon and Prasad, 2010) as well as the changes in life cycle earning profiles and incomplete pension reforms in China (Song and Yang, 2010).

In this paper, we propose and test a new hypothesis that demographic structural changes caused by a series of population control policies since the 1970s have contributed to changes in China's household saving patterns.[2] After the implementation of population control policies, birth rates for successive cohorts plummeted. Consequently, the demographic structure

[1] These findings are based on China's Urban Household Surveys (UHS), which are described in detail in the data section. See Chamon and Prasad (2010), Song and Yang (2010), and Yang, Zhang, and Zhou (2012) for systematic documentation of age-specific household saving patterns in urban China.

[2] The demographic transition would also affect other aspects of the economy. See Song et al. (2015) for a recent study on the inter-relationship between China's demographic transition and its economic growth and pension reforms.

shifted to a new regime in recent years in which young households have fewer siblings, middle-aged households have fewer dependent children, and older households have fewer adult children. In Chinese households, the younger generation traditionally provided support to their elderly parents. Having fewer siblings, younger households will save more because of the increasing burden of upstream transfer to their parents. Households with fewer dependent children can save more because of lower child care and education expenses. Older people also have more incentive to save for old-age security as a substitute for the reduced number of children.

We develop a simple overlapping generation (OLG) model to illustrate the effects of population control policies and demographic structural changes on saving decisions of individuals at different life stages. Incorporated into the model are structural features of the Chinese household: parents raise their dependent children who, in turn, become adult children who provide monetary transfers to their elderly parents as old-age support. The model allows parents to be altruistic (treating children as consumption goods) and use children for old-age support (treating children as investment goods). Population control policies differentially affect the numbers of siblings, dependent children, and adult children for households at different ages (i.e., from different birth cohorts). The model predicts three testable hypotheses following binding birth quota. First, the responsibility of parental care increases for adult children with fewer siblings and their saving rate will increase. Second, households with fewer dependent children will have higher savings because of fewer mouths to feed. Third, fewer adult children reduces old-age support for parents, thereby encouraging elders to save more. These predictions demonstrate how saving decisions of different cohorts respond to demographic structural changes. The behavioral model provides guidance for estimating the relative contributions of various factors behind the changes in the age-saving profile in China.

We test the model implications and estimate the effects of demographic structural changes on Chinese household saving using combined data from the Urban Household Surveys (UHS) and population censuses. The UHS contains information on consumption expenditure at the household level, but lacks detailed information on fertility histories. Thus, we match the 1989–1991 and the 2004–2006 UHS with the 1990 and 2005 population censuses for each single year-of-birth cohort in each province. The demographic structure experienced dramatic changes from 1990 to 2005 as a consequence of population control policies and other socioeconomic changes since the early 1970s. For example, compared to the 1990 data, in 2005 young households headed by individuals between 26 and 35 years old had 1.9 fewer siblings, middle-aged households headed by individuals in their 40s had 0.3 fewer dependent children, and old households led by individuals in their 50s had 1.8 fewer adult children.

The main empirical challenge in estimating the effects of demographic structural changes on savings is the endogenous nature of fertility decisions. Our identification relies on exogenous variations in cohort-specific fertility generated by the different timing of population control policies that affected different birth cohorts and by the interaction of birth cohorts with fines across provinces on unauthorized births under the one-child policy. Effective implementation of China's population control policies started in the early 1970s. The government tightened population control over time, and eventually, the one-child policy was implemented in 1979. After nearly forty years of practice, the policy was finally relaxed in 2015. Given the timing of the population control policies, cohorts at childbearing ages face downward pressure in fertility, whereas leaving fertility decisions largely unaffected for previous cohorts. The varying intensity of policies over time also implies that their effects on fertility differed for successive affected cohorts. Under the one-child policy, each family was allowed only one child in urban China, and fines were levied on second or higher-parity births. A unique feature of the policy was that the means of implementation and vigor of enforcement differed across provinces. In particular, the fines on excess birth varied significantly by province and year (Scharping, 2003; Ebenstein, 2010). To facilitate identification, we exploit the exogenous variability in fertility difference between provinces with different fines for successive cohorts that were exposed to population control policies of varying intensities.

Specifically, we use the interactions of provincial fertility fines with five-year cohort dummies as instruments for the number of children when estimating the effects of demographic structural changes on savings. The important observation underlying the identification strategy is that fertility fines may have differential effects on fertility decisions of different birth cohorts with varying fertility history at any given time. Note that this identification strategy does not require fertility fines to be exogenous.

Using cohort-level cross-sectional data for 1990 and 2005, we find systematic evidence that demographic structural changes have significant and sizable effects on saving rates. For instance, younger households between 26 and 35 years old increase saving rates by 3.0 to 4.5 percentage points with one less sibling. Middle-aged households between 41 and 50 years old save 12.7 to 23.1 percentage points more with one less dependent child. Older households between 51 and 60 years old increase their saving rates by 2.8 to 5.5 percentage points if they have one less adult child. These results confirm the three hypotheses derived from the model. Subject to caveats, simple "back-of-the-envelope" calculations based on our point estimates show that demographic structural changes as measured by variations in number of siblings, number of dependent children, and number of adult children are important to account for the increase in household saving rates between 1990 and 2005.

Although previous studies have explored the rising household saving rate in China in recent years, substantial uncertainty remains with regard to its driving forces. Existing research emphasizes the importance of sharp cost increases in health and education (Chamon and Prasad, 2010); competitive saving motive arising from the marriage market (Wei and Zhang, 2011); structural shifts in life-cycle earnings (Song and Yang, 2010); and the constraints of the household registration system (Chen, Lu, and Zhong, 2015). Given the dramatic changes in demographic structure, the existence of limited empirical evidence on its relationship with household age-saving profile is somewhat surprising. Several studies have attempted to investigate the link between demographic structure and household saving at the aggregate level (Modigliani and Cao, 2004; Horioka and Wan, 2007; Curtis, Lugauer, and Mark, 2015). Using a calibrated OLG model, Choukhmane, Coeurdacier, and Jin (2016) evaluated the contribution of the one-child policy to the rise in China's household saving. Banerjee et al. (2014) investigated the effects of fertility and child gender on parents' saving decisions in a general equilibrium setting. They used a sample of households headed by individuals between 50 and 65 years old, therefore studying only the saving behavior of *older* households. In contrast, we show that fertility influences saving behavior differently for households at various stages of their life cycle. Unlike previous studies, we highlight how *age-specific* saving decisions respond to demographic structural changes over time, and investigate the shift in the entire age-saving profile.

The rest of this paper is organized as follows. Section 2 briefly describes the evolution of China's population policies and their effects on demographic structure. Section 3 presents a simple OLG model that links population control policy, demographic structural change, and household saving. The model provides a framework to specify and interpret our empirical results. Section 4 describes the data and variables. Section 5 discusses the empirical strategy and presents the results on the effects of demographic changes on household saving rates by age. Section 6 provides the conclusions.

2 Population Control Policies in China

China witnessed major changes in its population policies over the past few decades, moving from encouraging population growth to strictly enforcing population control. In the early 1950s, Chinese families were encouraged to have children. Consequently, the population rose from 550 million in 1950 to 830 million by 1970. The rapid population growth during the 1950s and 1960s led to the "*Wan* (Later), *Xi* (Longer), *Shao* (Fewer)" campaign of the 1970s. This policy called for later marriage and child bearing, wider spacing between births, and fewer children. Education, propaganda, and persuasion were the officially stated means of policy implementation (Yang and Chen, 2004). Men were encouraged to marry no earlier than 28 years old and women no earlier than 25 years old. Couples were persuaded to allow at least a four-year gap after the first child before having another baby. Urban families were also encouraged to limit their number of children to two. The total fertility rate plummeted from close to 6 in 1970 to less than 3 by the end of the 1970s (Coale, 1984).

However, population growth remained high; the baby boomers of the 1950s and 1960s were entering their reproductive years, and by 1979, approximately two-thirds of the population were under 30 years old. When economic reform was launched in the late 1970s, the government considered curbing population growth to be essential to economic expansion and an improved standard of living. Thus, in 1979, the authorities tightened population control and introduced the one-child policy, allowing each household to have only one child. Households were given birth quotas, and "above-quota" births were penalized. This policy aimed to limit China's population to 1.2 billion by 2000. After the implementation of the one-child policy, the total fertility rate declined gradually from just below 3 in 1979 until it stabilized at approximately 1.7 in 1995 (Hesketh, Lu, and Zhu, 2005).

Despite its name, the one-child rule did not apply equally to all Chinese families. Ethnic minorities were initially excluded from the policy.[3] For urban residents and government employees of Han ethnicity, the one-child policy was strictly enforced, with few exceptions. If both parents came from single-child households, they were allowed to have more than one child provided that the birth spacing of children was more than four years. Families in which the first child had a mental or physical disability or both parents working in high-risk occupations (i.e., mining) were allowed to have another child.[4]

The State Family Planning Bureau set the overall population control targets and policy direction. However, the implementation of the policy varied from one locale to another.

[3] China officially recognizes 56 distinct ethnic groups, with Han Chinese being the largest and comprising approximately 92% of the total population. See Li and Zhang (2009) for details on the one-child policy applied to ethnic minorities.

[4] Our discussion on the population control policies has focused on urban areas as our empirical analysis is based on an urban sample. Population control was generally less strict in rural areas. For example, in rural areas, a second child was allowed after five years, but this provision sometimes applied only if the first child was a girl, in recognition of the traditional preference for boys and the reality of the need for male labor in rural areas.

Family-planning committees at the provincial and county levels devised local strategies for implementing the state policy of population control under the general principle of one child per couple. Residents of different provinces were subject to different birth limits as permitted by local policy (Gu et al. 2007). Economic incentives were provided for compliance, and noncompliance resulted in substantial fines and possibly other nonfinancial penalties. Various studies have shown that these fines were heavy and varied enormously across provinces. Fines ranged from 20% to 200% of a household's annual income (Short and Zhai, 1998; Ebenstein, 2010). Even at the lower end of the range, the fines were still substantial.

The rapid decrease in birth rate, combined with improving life expectancy, led to a significant change in the age structure of the Chinese population.[5] The decline in child dependency ratio (defined as the ratio between child population aged 14 years and below and the working-age population between 15 and 64 years, expressed in percentage) and rise in old-age dependency ratio (defined as the ratio between the population aged 65 years and above and the working-age population, expressed in percentage) were the major trends in China's demographic structure (Figure 2). We further plot the more detailed population structure change (United Nations, 2008) in Figure 3. In 1970, the population structure was a pyramid with a large base of young people. The number of children declined significantly over time as a consequence of population control policies. More relevant to this study, we observe a clear regime shift of population age structure between 1990 and 2010. The proportion of the population between 50 and 60 years old was 7% in 1990 and stood at 12% in 2010 and these age cohorts experienced a rapid fertility decline as shown by decrease in number of young workers in their 20s and early 30s. The proportion of the middle-aged individuals between 40 and 50 years old increased from 10% in 1990 to 16% in 2010, whereas their children's generation reduced in size. The proportion of the population below the age of 15 years was 28% in 1990 and dropped to 20% in 2010. In the Chinese tradition, children are a source of old-age support. However, the fertility decline induced by the population

[5] Another outcome of family planning was an increase in the male-female ratio in China (Ebenstein, 2010; Li, Yi, and Zhang, 2011).

control policies severely curtailed this tradition.

3 A Simple Theoretical Framework

We postulate that China's population control policies and demographic shifts have profoundly affected household saving behavior over life cycles. One major difficulty in assessing this effect is that concurrent with the implementation of family planning programs and the demographic transition since the early 1970s, fundamental socioeconomic changes have occurred in China. The rising household saving took place amidst China's transition to a market economy and rapid income growth. Institutional reforms occurred, whereby health care systems, education finance, pension arrangement, and other social welfare provisions evolved with the transition to a market economy. Other elements, such as rising household income, increasing overall macroeconomic uncertainty, housing reform, and rising housing price, occurred during the same period, and likely had an effect on household saving behavior.

In this section, we present a simple OLG model that focuses on the effects of population policies and demographic changes by holding other socioeconomic variables constant. The model is useful in justifying the empirical specification we use and in interpreting the empirical results. According to the model, changes in population control policies have different effects on saving rates for individuals at different points in their lifetime. We will investigate these relationships in the model and form empirical specifications based on them. In the empirical analysis, we will also consider the effects of other socioeconomic variables in addition to the demographic shifts induced by population control policies.

3.1 The Model

The economy is populated with overlapping generations, referred to as children, school-aged youth, young, middle-aged, and old workers, and the retired. We assume that people start making economic decisions when they become young workers. In each of the working-age periods, all workers supply one unit of labor inelastically. Let the socioeconomic environment and the information set available be denoted by ψ. The after-tax earnings of young, middle-aged, and old workers are denoted by y_1, y_2, and y_3, respectively. When people retire, they receive pension benefits of y_4.

A generic individual has children when young. Each individual has a utility function, $u(c, f)$, and extracts positive utility from both consumption (c) and quantity of children (f). For simplicity, we do not consider the quality of children. Given the socioeconomic environment, preference for a young worker can be represented by

$$\sum_{i=1}^{4} \beta^{i-1} u\left(c_i, f; \psi\right), \tag{1}$$

where β denotes the discount factor and c_i stands for consumption of an individual of age i ($i = 1, 2, 3$ refers to the three working ages, respectively, and $i = 4$ refers to retirement). In the empirical analysis, we will focus on the behaviors of working-age individuals with ages 26 to 60 years old. Almost all individuals have completed formal schooling by the age of 25. Meanwhile, by the age of 60, all Chinese workers are officially retired.

The model allows parents to be altruistic, and pay q to raise each child. The cost of children accrues over time from birth to school age, until the child becomes a working young adult. In the model, people have children as young adults, and as the children reach school age, the parents reach their middle age. For illustration, we assume that middle-aged parents pay cost q for their school-aged children. The child cost q includes household expenditure in terms of food, clothes, and shelter, opportunity cost in terms of parental time, and schooling expenses.

Following the Chinese tradition, parents also use children for old-age support. We assume a targeted level of old-age support for parent, R, which is equally shared among all adult children. Adult children are expected to care for their elderly parents after retirement. Given that early retirement starts at around age 50,[6] we assume that a young adult pays his/her

[6] The official retirement age is 50 for women in blue-collar jobs, 55 for other women, and 60 for men.

share of parental support R/n^s to old parents, where n^s is the number of siblings (including oneself). If no uncertainty arises and every child pays his/her share, an old parent receives a transfer of R from all children. Figure 4 presents the timeline of inter-generational transfers.

Although almost all parents would pay to raise their dependent children, the old-age support paid to elderly parents follows social norm and is considered voluntary. If some adult children do not pay for their parents' old-age support because of mortality risk, financial difficulty, or in defiance of tradition, the likelihood of securing old-age support from adult children would increase with the number of children. That is, old-age support R becomes an increasing function of the number of adult children, or $R'(f) > 0$. Furthermore, we assume that each adult child's share of parental care, $p(n^s) = R(n^s)/n^s$, decreases in the number of siblings, i.e., $p'(n^s) < 0$.

Therefore, a young worker chooses the optimal saving decision by maximizing lifetime utility subject to the following inter-temporal budget constraint:

$$c_1 + \frac{R(n^s)}{n^s} + \frac{c_2 + fq}{1+r} + \sum_{i=3}^{4} \frac{c_i}{(1+r)^{i-1}} = \sum_{i=1}^{4} \frac{y_i}{(1+r)^{i-1}} + \frac{R(f)}{(1+r)^2}, \tag{2}$$

where r is the interest rate. The fertility variable f represents both the number of dependent children for the middle-aged households and the number of adult children for the old households.

Assuming log utility in consumption and separability in consumption and number of children, the saving decision of the young solves

$$\max \sum_{i=1}^{4} \beta^{i-1} \log c_i\,(\psi) + \lambda G[f\,(\psi)]$$

subject to the budget constraint (2). Children enter parents' utility through function $G(\cdot)$, and parameter λ measures the degree to which parents care about their children. Parameter

Disabled workers may retire ten years earlier, and workers from bankrupt state-owned enterprises may retire five years earlier.

ψ represents the socioeconomic environment determined outside the model.

The Euler equation implies the following consumption pattern over the lifetime,

$$c_1(\psi) = \frac{c_2(\psi)}{\beta(1+r)} = \frac{c_3(\psi)}{\beta^2(1+r)^2} = \frac{c_4(\psi)}{\beta^3(1+r)^3}. \tag{3}$$

If fertility is optimally chosen, then the optimal number of children f^*, given ψ, satisfies

$$\rho\frac{q(1+r) - R'[f^*(\psi)]}{\lambda(1+r)^2 G'[f^*(\psi)]} + \frac{f^*(\psi)\,q}{1+r} = \sum_{i=1}^{4}\frac{y_i}{(1+r)^{i-1}} + T(f^*, n^s),$$

where $\rho = 1 + \beta + \beta^2 + \beta^3$, and the term $T(f^*, n^s) = R[f^*(\psi)]/(1+r)^2 - p(n^s)$ measures each individual's net gains through inter-generational transfers of old-age support. Positive T implies net positive transfer from children (as a parent), whereas negative T implies net transfer to parents (as a child). Transfers from children increase with the number of adult children, and the burden of parental support decreases with the number of siblings. Thus, net gain T increases both in the number of adult children and number of siblings.

It is easy to show that saving rate when young equals

$$s_1(\psi) = \frac{y_1 - c_1}{y_1} = 1 - \frac{1}{\rho} \times \left[\sum_{i=1}^{4}\frac{y_i}{y_1(1+r)^{i-1}} - \frac{f^*(\psi)\,q}{y_1(1+r)} + \frac{T(f^*, n^s)}{y_1}\right]. \tag{4}$$

For a young individual, the saving plan for the middle-age and old-age are given by

$$\begin{aligned} s_2(\psi) &= \frac{y_2 - c_2 - f^*(\psi)\,q}{y_2} \\ &= 1 - \frac{\beta}{\rho} \times \left[\sum_{i=1}^{4}\frac{y_i}{y_2(1+r)^{i-2}} + \frac{(1+\beta^2+\beta^3)f^*(\psi)\,q}{\beta y_2} + \frac{T(f^*, n^s)(1+r)}{y_2}\right]; \quad (5) \\ s_3(\psi) &= \frac{y_3 - c_3}{y_3} \\ &= 1 - \frac{\beta^2}{\rho} \times \left[\sum_{i=1}^{4}\frac{y_i}{y_3(1+r)^{i-3}} - \frac{(1+r)f^*(\psi)\,q}{y_3} + \frac{T(f^*, n^s)(1+r)^2}{y_3}\right]. \quad (6) \end{aligned}$$

In the initial equilibrium, no population control policy exists, and the socioeconomic environment is fixed at ψ. Equations (4) to (6) present household saving rates over the life cycle. If we assume further that all households face the same life-cycle earning profile, interest rate, and discount rate, then Equations (4) to (6) also illustrate the age-saving profile for a cross-section of households at a steady state equilibrium.[7]

For empirical analysis, we study cross sections of individuals at different life stages. In this context, Equations (4), (5) and (6) apply accordingly to the saving decisions of the young, middle-aged, and old households. Therefore, even if we assume same ψ for households of different birth cohorts, a given change in ψ would have different effects on the three cohorts. When socioeconomic environments change over time, thus accompanied with different ψ's for successive cohorts, further changes in ψ would lead to additional responses in saving behaviors across different cohorts. By similar reasoning, and regardless of specific household environments, Equations (4) to (6) imply that population policies, through its influence on f^* and n^s, would have different effects on individual savings at different stages of their life. Moreover, the resulting demographic structural changes would also have different effects on individuals across the three cohorts at a given time. The age-specific effects of demographic structural changes will be discussed further in the next section. For empirical work, we will carefully control socioeconomic conditions of the households.

[7] We admit that the introduction of inter-generational transfers complicates our definitions of saving rates. Our data provide rich information on government/social transfers, such as pension, social welfare, insurance, and housing accumulation fund but very limited information on household/private transfers. The item most closely related to inter-generational transfer recorded in the data is called "family support allowance." However, we are not able to identify the sources of this transfer: for example, whether this allowance is alimony income, child support payment, or transfer income from children or other family members is unclear. Inter-generational transfers may take different forms, such as cash transfers, in-kind transfers, or direct parental care (time spent with elderly parents). In our data, these different transfers cannot be distinguished. Cash transfers may affect children's disposable income, whereas in-kind transfers may appear as children's consumption expenditure in the data. In addition, the household surveys provide no information on direct parental care. Furthermore, saving rates are measured at the household level in the data. Inter-generational transfers, even in the form of cash transfers, will not affect household income if young adults live with their parents, as the transfers are recorded as the transfer expense for the young adults and transfer income for the elderly parents in the data. All the above-mentioned data limitations and complications show that our simple theoretical definitions of saving rates are most consistent with our empirical definitions derived from available data.

3.2 Population Control Policies

In the context of household saving decisions in China in the past two decades, households face many uncertainties amidst China's transition to a market economy and its rapid income growth. For example, the socioeconomic environment and demographic structure have both transformed dramatically over time. These shocks will likewise shift the saving profile over time. In this paper, we are particularly interested in the effects of demographic changes caused by population control policy on saving rates.

Suppose that the state population policy set the maximum number of children each couple can have at $\overline{f}$ and $\overline{f} < f^*$. Given the binding birth quota, households make constrained optimization by setting $f = \overline{f}$. Initially, households that had passed childbearing age were unaffected by the policy. However, the policy might come as a surprise for those affected by it. For instance, a 26-year-old woman in 1977 did not anticipate the one-child policy and made a lifetime saving decision based on her optimal fertility rate, say $f^* = 2$. At age 28, the one-child policy was implemented, such that each family had a birth quota of $\overline{f} = 1$. If the household had not reached its optimum of two children, it would reoptimize at age 28 given its accumulated assets at age 27. The marginal effects of fertility reduction on saving generated by an unanticipated change in population policy differ from those generated by the same but anticipated change in the policy.

Eventually, the economy will converge to a new steady state equilibrium in which all individuals are exposed to the population control policy and fully anticipate the fertility constraint. At this equilibrium, the consumption pattern of the households still follows Equation (3). Optimal consumption over a lifetime can be solved by combining the budget constraint (2) and first-order conditions (3). The saving rates for households of different ages are determined using Equations (4) to (6) by replacing f^* and n^s with $\overline{f}$, when lifetime earnings and other socioeconomic variables are held constant. As Equations (4) to (6) show, changes in the number of children or siblings induced by the population policy have different effects on saving rates of individuals at different points of their lifetime.

Formally, we take derivatives of saving rates in Equations (4) to (6) with respect to f and obtain the following partial derivatives:

$$\frac{\partial s_1}{\partial f} = \frac{1}{\rho y_1(1+r)}\left[q - \frac{R'(f)}{1+r}\right], \tag{7}$$

$$\frac{\partial s_2}{\partial f} = -\frac{q(1+\beta^2+\beta^3)}{\rho y_2} - \frac{\beta R'(f)}{\rho y_2(1+r)}, \tag{8}$$

$$\frac{\partial s_3}{\partial f} = \frac{\beta^2(1+r)}{\rho y_3}\left[q - \frac{R'(f)}{1+r}\right]. \tag{9}$$

Similarly, derivatives of saving rates with respect to n^s are

$$\frac{\partial s_1}{\partial n^s} = \frac{1}{\rho y_1} p'(n^s), \tag{10}$$

$$\frac{\partial s_2}{\partial n^s} = \frac{\beta(1+r)}{\rho y_2} p'(n^s), \tag{11}$$

$$\frac{\partial s_3}{\partial n^s} = \frac{\beta^2(1+r)^2}{\rho y_3} p'(n^s). \tag{12}$$

A few decades are required for all birth cohorts in an economy to be fully exposed to the population control policy and reach constrained optimization. A more relevant analysis for our purpose is to consider the response of households of different ages to the implementation of the population control policies since the early 1970s. Specifically, we focus on three age groups in 2005, and investigate how their saving behavior changed relative to the benchmark steady state equilibrium without family planning.

For old households in 2005, the number of siblings is unaffected by the population control policies. As the number of children (f) decreases, as shown in Equations (6) and (9), two opposing effects on their saving occur. The first effect is the substitution between old-age support from adult children and own saving. When people have fewer adult children, the net transfer decreases and precautionary saving is induced because of old-age security concerns. The possibility that precautionary motive induced by fewer number of adult children could interact with other uncertainties also exists. For example, if public pension is reduced, people will rely more on private saving or children's old-age support for retirement. In this case, the reduced old-age support because of fewer adult children may induce even more private savings. An indirect effect of the number of children on the savings of old households also emerges. Such households supported fewer dependent children when they were younger. As expenditure on dependent children decreases, more income becomes available for consumption over the lifetime. Therefore, consumption expenditure increases and people save less, as shown in the second term in the bracket in Equation (6). As shown in Equation (9), the effect of fertility decline on the saving rate of old households is theoretically ambiguous. Under the parameter restriction $q < R'(f)/(1+r)$, we obtain $\partial s_3/\partial f < 0$. This leads to the following hypothesis.

Hypothesis 1: As the number of adult children decreases, old households will save more for the purpose of old-age security if the cost of children is not too large.

For middle-aged households in 2005, the number of siblings was also unaffected by the population policies. After the policies' implementation, these households had fewer dependent children and fewer mouths to feed. Thus, they could spend less on children and save more, as shown by replacing f^* with $\overline{f}$ in the second term in the bracket in Equation (5). According to Equation (8), $\partial s_2/\partial f < 0$, as $q > 0$ and $R'(f) > 0$. The number of mouths to feed effect should apply to any household with dependent children. This inference leads to the second hypothesis derived from the model that can be tested empirically.

Hypothesis 2: As the number of dependent children decreases, savings of middle-aged households will increase because of fewer mouths to feed.

Younger households in 2005 were not only subject to the birth quota, but their parents' fertility decisions were also likely affected by population control policies. Thus, they had fewer children and fewer siblings compared to birth cohorts in the benchmark steady state equilibrium. The effect of fewer children on young households' saving rate is theoretically indeterminate as shown in Equations (4) and (7). In Equation (4), as the number of siblings

(n^s) declines, each person's burden of parental care increases and the net transfer from children goes down. Therefore, individuals will consume less and save more. Formally, $\partial s_1/\partial n^s < 0$ because $p'(n^s) < 0$, as shown in Equation (10).

Hypothesis 3: As the number of siblings decreases, young households will save more to provide old-age support to parents.

When China initiated population control in the 1970s, and implemented the one-child policy in 1979, we expect changes in the saving behavior of all age cohorts that had not yet completed their fertility. Therefore, a fraction of the population would start changing their savings behavior in the short run. Households engaged in consumption smoothing over their life-cycle, hence, population controls would affect saving behavior of successive cohorts over several decades after their implementation. With exogenous variations in demographic changes, we can test the above hypotheses, assess their effects on household savings, and explain the changes in age-saving profiles over time.

Admittedly, China has undergone profound socioeconomic changes concurrently with the implementation of its population control programs. The simple model presented in this section takes all of these factors as given and focuses on the effects of population policies on household savings. In the empirical analysis, we will try to specify these socioeconomic factors more explicitly.

4 Data

Our empirical analysis aims to test the hypotheses postulated in the model and assess the effects of population control policies and demographic structural changes on household savings. A data set suited to our purpose should contain the following: first, accurate measures of household saving rates for multiple years; second, cohort-specific data on family composition, including complete information on the numbers of adult children, dependent children, and siblings for successive cohorts; third, good measures of time or regional variations in population control policies; and fourth, other household demographic information and socioeconomic variables that may affect saving decision. To fulfill the data requirement on saving rates, repeated household income and expenditure surveys are necessary. Although household surveys often have rich demographic information, they are typically residency-based; thus, a household member is observed only if the person lives with the household head. The majority of adult children and some dependent children in post-secondary school do not live with parents, and adult siblings typically live in separate households. Therefore, complete family composition information that fits our needs cannot be inferred at the household level. The household sample alone is insufficient to test the model hypotheses.

Our strategy is to construct a cohort-based sample that meets all data requirements using multiple data sources. The saving data we use come from the UHS conducted by China's National Bureau of Statistics (NBS). UHS is an on-going income and expenditure survey of Chinese urban households, and is known to be the best micro data on household savings in China. The survey also records detailed information on employment, wages, and demographic characteristics of all household members in each calendar year. The second main data source is the Chinese population censuses. The censuses contain the most comprehensive demographic information on Chinese households and provide information on the family composition of different cohorts. We match them with saving information of the same cohorts from the UHS. We likewise collect province- and time-specific fine/income ratio, which is the ratio between above-quota fertility fines and annual household income under the one-child policy, as a measure for the strictness of the population control policy. We also collect other socioeconomic variables that may affect household saving from various sources. The strength of our cohort-based sample is that it not only combines the best available household saving data with the most comprehensive demographic information, but also contains policy variations that facilitate identification.

For the current analysis, we use UHS data from six provinces broadly representative of China's rich regional variation, namely, Beijing, Liaoning, Zhejiang, Sichuan, Guangdong, and Shaanxi. Beijing is the rapidly growing capital city in the north; Guangdong and Zhejiang are dynamic high-growth provinces in the south coastal region; Liaoning is a province known for its heavy industries in the northeast; and Sichuan and Shaanxi are relatively less developed inland provinces located in the southwest and northwest, respectively. In the UHS, each household reports data on expenditure on different commodities. We construct a standard measure of household consumption that includes expenditure on goods and services (including rent), interest payments on mortgages, vehicle loans and other loans, cash contributions to organizations, and insurance premiums. We also consider alternative consumption measures that exclude various items, which might be considered as savings. Specifically, we exclude expenditure on durables, health and education (which can be considered as investment in human capital), and mortgage payments. Income is defined as total disposable family income, including earnings, transfers, capital income, and pensions net of all income taxes and social security contributions. Saving is defined as the difference between disposable income and consumption.[8] Saving rates are computed as the ratio of saving to income. Using alternative household consumption measures do not cause major changes to the facts documented below, except for saving rates after retirement. Saving rates after retirement are not quantitatively important; hence, throughout the paper, we focus on the saving behavior of working-age households with household heads aged between 26 and 55 (for female) or 60 (for male).

We use UHS data to construct household age-saving profiles for 1990 and 2005. Given the limited sample size, we combine observations from the 1989–1991 surveys as representing 1990 and similarly, observations from 2004–2006 as representing 2005. An age-specific saving rate is derived from averaging the household saving rates for all households with the same

[8] The saving definition we adopt treats social security contribution as taxes, but this contribution can also be recognized as mandatory life-cycle saving (Jappelli and Modigliani, 2003). We could not construct a consistent saving measure including social security contribution because of the absence of information for social security contribution in the 1989-1991 UHS. For the 2004-2006 period, households on average contribute 5.2% to 8.4% of the household income to social security, with households between age 41 and 50 making the highest contribution. Therefore, the 2004-2006 age-saving profile in Figure 1A would be higher and the U-shape slightly less pronounced if social security contribution is included.

age in each period. Panel A of Figure 1 presents age-saving profiles for the two periods. Considering that some age cells contain few observations, we use three-age moving average to minimize the effects of measurement error. In the 1989–1991 period, the saving rates are relatively flat before age 40 and then increase toward the retirement age. For 2004–2006, the age-saving profile exhibits a dramatic change: it turns to a U-shape. Using alternative saving definitions results in a qualitatively similar U-shaped profile, we further eliminate fixed life-cycle effects by taking the difference of the two profiles. The outcome yields an increase in saving rates by age from 1989–1991 to 2004-2006, as depicted in panel B of Figure 1. The U-shaped pattern becomes more pronounced: the average increase of saving rates for those aged below 40 and above 50 is equal to 10.7 and 7.6 percentage points, respectively, whereas the increase for those between 40 and 50 years old is only 3.5 percentage points. The rise in saving rates of the young and the old among working-age households sharply contrasts with the typical hump-shaped or relatively flat age-saving profile.[9]

Each age cohort between 26 and 60 in 1990 and 2005 corresponds to a birth cohort born between 1930 and 1979; they had different exposure under China's population policies over time. Among them, the older ones born in the 1930s had children in the 1950s and 1960s when no population control policy was implemented; those born in the 1940s and early 1950s experienced the "Later, Longer, Fewer" family planning program in the 1970s; those born in the late 1950s and onwards were all subject to the one-child policy at their childbearing age; and the youngest cohort was likely born as the only child in the family. Hence, to construct cohort-specific family composition and demographic structure variables potentially affected by the population control policies, we match the 1989–1991 and 2004–2006 UHS households with the 1990 population census and the 2005 1% population survey. We use the census urban samples in the corresponding six provinces for consistency with the households from the UHS. In the censuses, all women aged between 15 and 64 report the number of children born to them, and each person in a household can be identified. We consider three demographic

[9] For subsamples classified by household head's education and gender, they also feature a U-shaped level in 2005, as well as a U-shaped increase of saving profile.

variables investigated in the model and affected by population policies. First, we construct a variable on cohort-specific average number of children ever born, for households of each age cohort between 26 and 60 in 1990 and 2005 for each province. Although savings data from UHS are collected based on the age of the household head, fertility information is obtained from census from women. The number of children is therefore computed as a weighted average using the gender and marital status distribution of household heads.[10] In the empirical analysis, we use this variable as a proxy for the number of adult children. Second, we create a variable on the number of dependent children. Dependent children are defined as children aged below 15 and those above age 15 but still attending school. We count the number of dependent children each household has and compute the average conditional on the household head's age. Finally, we investigate the number of siblings for each age cohort. Although we have information on how many children people have from the population censuses, information on the number of siblings is unavailable. We proxy the number of siblings by locating their parents' birth cohorts and collecting information on the number of children born to those cohorts.[11]

Panel A of Figure 5 presents the age-specific average number of children born from the 1990 census and 2005 mini-census. In 1990, the young households between 26 and 35 years old have one child on average. These households were below the age of 24 in 1979, when the one-child policy was first implemented, and therefore were constrained by the policy. Those over the age of 35 have more children because their corresponding birth cohorts have

[10] In particular, consider all household heads at age a in year t, and let j denote household type, such that $j = 1$ corresponds to single male, and $j = 2, 3, 4$ corresponds to married male, single female, and married female, respectively. We first compute the proportions of households given the heads' gender and marital status $P^j_{a,t}$. From the censuses, women of all ages report the number of children ever born. Therefore, we have fertility information for all female cohorts $F^j_{a,t}$ with $j = 3, 4$. Now, we assume that single men have no children. Men tend to marry younger women, and we identified the average age of women, a', married to men at age a in year t. The weighted fertility for age cohort a at time t in our sample is then computed as $P^2_{a,t}F^4_{a',t} + P^3_{a,t}F^3_{a,t} + P^4_{a,t}F^4_{a,t}$.

[11] For example, those who were 40 years old in 2005 were born in 1965. Suppose that on average, their parents gave birth at the age of 25. Thus, their parents belong to the 1940 birth cohort. We use the average fertility rates of 50-year-old individuals in 1990, who were born in 1940, as proxy for the number of siblings for the 1965 birth cohort. We use the 1982, 1990, and 2005 censuses to construct the variable on the number of siblings.

had children or passed their child-bearing ages when the one-child policy was imposed. The increase in number of children by age reflects both the cumulative fertility effect over the life cycle, and the declining fertility rate over time since the mid-1960s, under various population control policies. In 2005, the age profile shows a dramatic change: the number of children is around one for all households between 26 and 50 years old, and then increases and reaches above 2 at the age of 60. This pattern is closely related to the population control policies. Those aged between 26 and 50 years in the 2005 mini-census were all younger than 24 years when the one-child policy was imposed, and therefore were subject to the birth quota. We further eliminate fixed life-cycle effects by taking the difference of the two profiles. The outcome yields the decline in the number of children over age from 1990 to 2005, as depicted in Panel B of Figure 5. Households of all ages have fewer children in 2005, but the change is much more pronounced for older households. The average decline for those aged between 26 and 35 years is 0.15 children. The decline increases in age. By age 50, households in 2005 have 1.6 fewer children on average compared with the 1990 households. If parents rely on adult children for old-age support, the decrease in the number of children will have a larger effect on older households.

In Figure 6, we present the changes in the number of dependent children from 1990 to 2005. Panel A shows a hump-shaped age profile of dependent children. The number of dependent children increases with the age of household heads, reaching a peak at around age 40, and then declining as children enter adulthood and leave the household. The 2005 age profile is lower than that of 1990 as the fertility rate declines. Panel B of Figure 6 shows that for those between 26 and 40 years old, the 2005 households have 0.5 fewer dependent children on average compared with the 1990 households. These households have fewer dependent children to raise and thus are more likely to save more. For older households, changes in the number of dependent children from 1990 to 2005 are much smaller.

Old-age support to parents is typically shared among siblings. Therefore, one's responsibility for parental care depends on his/her number of siblings. Panel A of Figure 7 presents the age-specific average number of siblings (including oneself) in 1990 and 2005. Even the very young households in 1990 were born in the 1960s, before the implementation of population control policies. Young households between 26 and 35 years old had below four siblings, whereas older households had slightly more than four siblings. In 2005, household heads belong to much younger birth cohorts, and were born between 1945 and 1979. Although the one-child policy had limited effect on them, these younger households experienced a dramatic demographic transition in the 1970s because of the "Later, Longer, Fewer" campaign and other socioeconomic changes. The average number of siblings increased from just above one to more than four across age cohorts. Panel B of Figure 7 plots the changes in the number of siblings by age from 1990 to 2005. Consistent with declining fertility rates, the number of siblings decreases by around two for the very young households. The changes over time are much smaller for older households–for those aged 50 and above, the number of siblings barely changes.

Combining household age-specific saving data from the UHS and demographic information of the corresponding birth cohorts from censuses, we construct a unique data set based on age cohorts. We also explore the geographic variations in savings and demographic structural change. Average saving rates are computed for all households with the same age between 26 and 60 years old in 1990 or 2005, located in one of the six provinces. Accordingly, demographic variables including the number of children ever born, the number of dependent children, and the number of siblings are constructed for the corresponding age cohorts in each time period and province. We also consider other variables that may affect household savings. For each age cohort in the sample, we construct variables on demographic characteristics, such as the proportion of people with high school education or above, the proportion of minorities, and the proportion of state employees. Following Wei and Zhang (2011), we use the local sex ratio for age cohorts between 7 and 21 years to measure the competitiveness of the marriage market. The other province- and time-specific socioeconomic variable we consider is government spending on social security per person, taken from the statistical yearbooks. Finally, under the one-child policy, the strictness of the policy can be measured by province- and time-specific fine/income ratio for unauthorized births. This aspect provides an important source of variation for the demographic structural change. The fine/income ratio is defined as the ratio between above-quota fertility fines and annual household income, taken from Ebenstein (2010).

Summary statistics are presented in Table 1. The sample consists of 416 observations,[12] with an average saving rate increase from 16.07% to 21.47%. As a result of the population control policies and demographic transition, the average number of children declined from 1.99 to 1.22 between 1990 and 2005, the average number of dependent children dropped from 0.57 to 0.40, and the average number of siblings decreased from 4.01 to 3.17 during the same time period. Between 1990 and 2005, the average working-age households became more educated, with high school completion rate increasing from 36.8% to 52.9%. Life expectancy increased from 70.2 in 1990 to 73.1 in 2005, and the share of state employment dropped from 81.0% to 46.6%. Government spending on social security per person also increased significantly over time. The sex ratio rose from 104 in 1990 to 113 in 2005, reflecting the increasing sex imbalance in China in recent decades. During the same period, average fertility fines increased from 1.24 times that of the annual household income to 3.25, while the proportion of minorities expanded from 2.4% to 3.6%.

5 Empirical Analysis

Our goal is to quantify the effects of demographic structural changes influenced by China's population control policies on the changes in age-saving profiles between 1990 and 2005. The empirical strategy follows two steps. First, we use data from the UHS, supplemented by information from successive age cohorts in the 1990 population census and the 2005 mini-census, to estimate empirically the marginal effects of the three demographic variables, including the

[12] We have data for 35 age cohorts (between age 26 and 60) in two years and in six provinces ($35 \times 2 \times 6 = 420$). Four observations are missing because saving rates are not observed for the corresponding age, year, and province combinations.

numbers of adult children, dependent children, and siblings, on household saving rates. The theoretical model provides guidance in formulating our empirical specifications, developing an identification strategy, and in interpreting our empirical findings. In the second step, we compute the contributions of observed demographic structural changes documented in Figures 5–7 to the rise in household saving rates, as well as the changes in age-saving profiles between 1990 and 2005, by using the estimates from the first step.

5.1 Empirical Specifications

Based on the three hypotheses previously discussed, we model saving rates as a function of the numbers of adult children, dependent children, and siblings to capture the effects of demographic structure on savings. As shown in the behavioral model, changes in demographic structure have different effects on households' saving rates at different points in their lifetime. Therefore, the effects of demographic variables on savings are age-dependent. In the most flexible specification, we may allow these variables to have interactions with all ages between 26 and 60 years old in the saving equation. However, this specification is not feasible because of the small size of our cohort-based sample. Instead, we define seven age-interval dummies ($i = 1, 2, ..., 7$) corresponding to ages between 26–30, 31–35, ..., 56–60, by assuming that the effects of the three demographic variables on savings are the same within each five-year age interval, but vary across age intervals.

Although we mainly investigate the linkages between demographic changes and household savings, we also incorporate other socioeconomic determinants of saving postulated in the literature into our empirical framework. We specify the following savings equation with the interactions of all demographic variables with age-interval dummies:

$$\begin{aligned} S_{a,j,t} &= \alpha_0 + \sum_{i=5}^{7} \beta_i I(a \in i) F_{a,j,t} + \sum_{i=3}^{5} \gamma_i I(a \in i) D_{a,j,t} + \sum_{i=1}^{3} \delta_i I(a \in i) N^s_{a,j,t} \\ &\quad + g(age) + \mathbf{X}_{a,j,t}\boldsymbol{\theta} + v_j + \varepsilon_{a,j,t}, \end{aligned} \tag{13}$$

where $S_{a,j,t}$ is the average saving rates for households with household head of age a in province j at time t. $F_{a,j,t}$ and $D_{a,j,t}$ are the numbers of adult children and dependent children in these households, respectively. $N^s_{a,j,t}$ is the number of siblings. The seven age-interval dummies $(i = 1, 2, ..., 7)$ correspond to five-year age intervals between 26–30, 31–35, ..., 56–60, and $I(\cdot)$ is an indicator function that is equal to one if the household's age a lies within interval i and zero otherwise. Thus, the coefficients β_i, γ_i, and δ_i provide estimates for age-specific effects of demographic structure on household savings. $g(\cdot)$ is a function of age that controls for life-cycle saving effects. To capture province-specific effects, we also allow for province dummies v_j. X is a vector of other control variables, which relaxes the assumption of the theoretical model that socioeconomic environment (ψ) is fixed over time.

In the saving Equation (13), we focus on selected age intervals for each demographic variable. This specification is based mostly on the empirical revelation of individual behavior and various specification tests. In reality, young workers may worry little about their own old-age security, and may not have complete information on the total number of children they will have eventually because of child mortality and other changing circumstances. When they approach retirement age, the old-age security concern based on the number of adult children will start to mount. Therefore, the number of children effect because of old-age security is most relevant for older households, and thus we consider the interactions of the number of children with age dummies between 46 and 60.[13] The number of mouths to feed effect only exists for households with dependent children. For those above the age of 50, their children have already become young adults; therefore, no dependent children effect on saving decision should emerge. Thus, we consider the interactions of dependent children with age dummies between 36 and 50 years old as they are young enough to have dependent children.[14] Concern on old-age support of parents should be most relevant for younger households. The

[13]As shown in Figure 5, given the timing of the population control policies, the number of children that young households have barely changed from 1990 to 2005 . Thus, the rise in precautionary saving for old-age security induced by fewer children should be most relevant for the older households.

[14]The cost of raising children is relatively low before they go to high school because of the nine-year compulsory public school system. After nine years, education costs increase, especially for college education.

reason is that many of the parents of those aged above 45 have passed away. Therefore, we include the interactions of the number of siblings with age dummies between 26 and 40 years old because their parents are either close to retirement or have retired, but are still around. To relax the assumptions on specific age cutoffs, we specify a full set of age-interval interactions with all demographic variables, and the results are presented in Appendix Table A. Most of the additional interaction terms have insignificant coefficients, and they do not substantially affect our main results.[15] These findings provide evidence that demographic effects on savings are indeed time sensitive, as expected.

5.2 Identification Strategy

The estimation of Equation (13) on Chinese data poses a number of challenges. The main challenge is the possibility that individual (and unobserved) heterogeneity in saving behavior is related to the fertility decision. For example, if more frugal households save more and systematically have fewer children, the OLS estimates of the coefficient on the number of children in cross-sectional studies will be downward biased. However, a shortcoming of studies that rely on time-series variation is that the fertility trend has generally gone down since the mid-1960s, whereas savings trend has gone up. From a simple time-series study, determining whether the negative relationship between fertility and savings is causal or because of some other variables that have also trended over time is difficult.

Another concern on our specifications is that the migration of households across provinces could bias the estimates. For example, suppose we observe the saving rate and the number of siblings of 30-year-old individuals in Zhejiang in 1990. If they were born in the province of Guangdong instead, our estimates are biased because the relevant number of siblings is that of Guangdong province. Prior to the recent tide of rural-to-urban migration, a Household Registration (*hukou*) System imposed a strict restriction on individuals changing their per-

[15] Another concern on the specification with full age-interval interactions is that the number of children ever born is highly correlated with the number of dependent children for households below age 45; however, as children become adults and leave home, these two variables become more distinguishable.

manent place of residence in China. In recent years, although the number of rural migrant workers in urban areas has increased dramatically, migrant workers still have considerable difficulty in obtaining urban registration. Households that live in urban areas but have no urban registrations were not sampled in the UHS before 2002. The sample coverage has expanded since 2002, but only slightly more than 1% of the individuals can be identified as migrant workers even in the expanded sample. Therefore, our sample is essentially restricted to urban households with urban registration. For this group of households, measurement error introduced by migration is very limited.

To identify the effects of three demographic variables (i.e., the numbers of adult children, dependent children, and siblings on household saving rates), we need to find exogenous variations in them. The number of siblings is pre-determined for household saving decision because one's current period saving decision is unrelated to their parents' fertility decision. Thus, we concentrate on finding instruments for the number of adult children and the number of dependent children to address the bias caused by endogenous fertility decision. China's population control policies substantially changed fertility for the cohorts exposed to the policies at their childbearing age. Important modifications have been made to the population control policies over time, and the means of implementation and vigor of enforcement of the policies differ significantly across provinces. The birth cohort and the province of residence jointly determine an individual's exposure to the population control policies. For example, a woman born in 1940 was 39 years old in 1979, when the one-child policy was first introduced. She had most likely passed her childbearing age, and the one-child policy should have a limited effect on her fertility decision. A woman born in 1960 was 19 years old in 1979, and was fully exposed to the policy. In addition, the intensity of the policy implementation measured by fines levied on unauthorized births varied significantly across provinces and over time (Scharping 2003, Ebenstein 2010). We exploit the exogenous variability in cohort-specific fertility generated by the different timing of population control policies that affected different birth cohorts and by the interaction of birth cohorts with fines across provinces on unauthorized births under the one-child policy. We also exploit exogenous variations in fertility generated by the fact that ethnic minorities were initially excluded from population controls and were less affected by population control policies in later years. Specifically, we use interactions of provincial-level fines for unauthorized births with cohort dummies and the share of ethnic minority as instruments to identify the effects of the numbers of adult children and dependent children on household savings. The population control policies provide the possibility of implementing such a technique as they induced changes in fertility, which varied systematically across cohorts, provinces, and ethnic groups. Our econometric approach and identification strategy are similar to those used by Attanasio and Brugiavini (2003), and Li and Zhang (2009).[16]

5.3 Estimation Results

We estimate Specification (13) on the cohort-based sample and report estimation results in Table 2. We instrument the number of adult children and the number of dependent children by minority share and the interactions of cohort dummies and provincial fertility fines measured as the ratio of annual household income. Individuals in our sample were born between 1930 and 1979. Cohort dummies are defined for each five-year cohort intervals. The instrumental variables include the interactions between province- and year-specific fine/income ratios and cohort dummies between 1945 and 1979, as women born before 1945 had likely passed their child-bearing age by 1990 and were unaffected by fertility fines in either 1990 or 2005.[17] In Appendix Table C, we present the first-stage estimation results with the number of adult children and the number of dependent children as dependent variables in Columns (1) and (2), respectively. In the first column, all seven instruments related to fertility fines are negative and significant, suggesting that the fines have a negative effect on fertility for

[16] Attanasio and Brugiavini (2003) exploited the differential effects of the 1992 Italian pension reform across cohorts and occupational groups to study household saving response. Li and Zhang (2009) also used the interaction of age with fertility fines as an instrumental variable to test the external effect of household demand for children.

[17] We present the ordinary least squares (OLS) estimates of Equation (13) in Appendix Table B.

cohorts born after 1945. Minority share has a positive and significant effect on fertility as population control is less strictly enforced on minorities. The fertility fine also has a negative and mostly significant effect on the number of dependent children for cohorts born between the years 1955 and 1979. In both regressions, the F-statistics for the joint test of IVs are very large [$F(8, 406) = 87.81$ and $F(8, 406) = 28.80$], thereby suggesting that these IVs have a high explanatory power for the endogenous variables.

In Table 2, we regress saving rates on demographics and other control variables. The numbers of adult and dependent children are first predicted using the full set of instrumental variables, including minority share and interactions of seven cohort dummies with province-year fertility fines for excess birth. The table has six columns corresponding to six specifications with and without additional control variables. Standard errors are presented in the parentheses, and they are adjusted to take into account the use of the predicted values of the numbers of adult and dependent children in the second stage. We also cluster the standard errors at the province and cohort levels to allow for errors to be correlated both within the province and within the cohort.[18] We let the coefficients on demographic structure be dependent on age intervals as in Equation (13), to allow for the possibility that the effects of demographic structural changes on household savings vary by age.

In Column 1 of Table 2, we report regression results with only three demographic variables that interact with selected age-interval dummies. With the exogenous variations in fertility coming from province-specific fertility fines interacted with cohort dummies, an issue of adult and dependent children being simply proxies for other unobservable province effects may arise. Thus, we include province dummies in the regression. The number of adult children has a significantly negative effect on saving for older households. One less child is associated with a rise in saving rate by 3.9 percentage points for those between age 51 and 55, and by 2.8 percentage points for those between age 56 and 60. In other words, as workers approach or reach retirement age, their saving decision begins to respond to the number of

[18] We use the estimator proposed by Cameron, Gelbach, and Miller (2011). The stata file for multiway clustering is available at www.econ.ucdavis.edu/faculty/dlmiller/statafiles.

offspring they have. Older households save more when they have fewer children. These results are consistent with older households' saving responses to old-age security concern discussed in Hypothesis 1. For households with dependent children, having fewer mouths to feed is generally associated with higher saving; however, the effect is larger and significant for those between 41 and 50 years old. China adopts a nine-year compulsory school system. Public schools are relatively cheap, but college education is costly. This reality may explain our results, indicating that dependent children in their late teens and early 20s cost parents the most.[19] This pattern is consistent with Hypothesis 2. The number of siblings has a negative and significant effect on saving rates for households between 26 and 40 years old. For workers who worry about old-age support of their parents, the burden for old-age care becomes more eminent when their parents draw near or have reached their retirement age. If they have fewer siblings to share the responsibility of parental care, these workers need to save more. Our estimates indicate that one less sibling is associated with a 2.9 to 4.4 percentage point increase in saving rates for workers between 26 and 40 years old. These results confirm Hypothesis 3.

The three variables that reflect demographic structural changes have age-specific effects on household saving; thus, age could have a direct effect on saving rates, and the interaction terms could simply reflect life-cycle patterns. In Column 2 of Table 2, we add age, age squared, and age cubic as additional controls. The coefficients on age variables are not statistically different from zero. With age controls, the coefficient for the number of dependent children has a negative effect on savings and becomes statistically significant for individuals between 36 to 40 years old. All other coefficients on the numbers of adult children, dependent children, and siblings are robust after we control for the life-cycle saving effects. The point estimates have the same sign and are close in magnitude compared with those in Column 1.

Other factors have been widely used to explain saving patterns. In Column 3 of Table

[19] Household expenditure data from UHS also reveal similar patterns. Among households that pay for schooling expenses, those headed by individuals between 41 and 50 years old pay the highest proportion (about 13%) of their household income on education-related expenditure.

2, we include expected future earnings as an additional regressor to account for a life-cycle earning effect, and include the proportion of individuals with high school education or above and life expectancy as proxies for saving preferences.[20] The estimated effects of demographic structure on household savings from this augmented model do not change significantly, except for the sibling effects on those households between 36 and 40 years old, which have become statistically insignificant. Moreover, individuals who expect high future earnings tend to save less, although the estimated effects are not statistically significant.[21] Individuals with at least high school education tend to save more than those with lower education, and individuals with longer life expectancy tend to save less; however, both effects are statistically insignificant.[22]

Previous literature has hypothesized that job uncertainty motivates Chinese families to save more. In Column 4, we use the proportion of individuals who work for state-owned firms or government agencies as proxy for the degree of job security. The argument that declining social security can contribute to the rise in savings in China has also been proposed (Chamon and Prasad, 2010; Song and Yang, 2010). Thus, we include per capita government spending on social security in a province as proxy for the extent of the local social safety net. Under the precautionary saving hypothesis, saving rates should decline with better job security and better social security coverage. Both estimated coefficients are negative, and the social

[20] Expected future earnings are the present value of future earnings normalized by the level of current earnings. We first use observed earnings to estimate an age-earning profile in each year and province. The projected earnings are then used to compute the present value of future earnings, where the discount rate is set at 0.97. As our estimates of expected future earnings are likely to be error-ridden, we use cohort dummies to instrument for them by following Attanasio and Brugiavini (2003).

[21] Another potential complication lies in the earnings of adult children. While the number of children available for old-age support is less because of population controls, the richer children of more recent cohorts can compensate for the predicted loss in old-age support due to fewer children, although factors such as increases in the cost of living may partially neutralize the effect. Combing these factors, a downward bias in the estimated effect of children on saving rates is likely to occur. This potential bias is difficult to correct because information on the earnings of children is unavailable in either the population census or the UHS.

[22] Interest rate and costs for college education are two other important variables in household decision making. However, we are not able to include them as additional control variables because they lack variations in the data. Interest rates were controlled by the government in China; thus, we do not observe any variation at individual or provincial level during our sample periods. Although we have some information on provincial-level college tuition and miscellaneous fee, we have no information on where an individual attends a college. As many Chinese students attend colleges outside their home provinces, we are not able to pinpoint individuals' costs for college education.

security effect is statistically significant. These results support the precautionary saving motive, but the coefficients on demographic variables that interact with selected age-interval dummies remain negative and statistically significant. This outcome suggests that the effects of demographic changes on saving are robust to the precautionary saving motive.

In Columns 5 and 6, we test whether the effects of demographic changes on saving are robust to the competitive saving motive. Following Wei and Zhang (2011), we include local sex ratio in our regression to capture potential competitive saving motive. To control for the potential endogeneity and measurement errors of local sex ratio, we use local fertility fine rate and minority share as instrumental variables and present the first-stage results in Column 3 of Appendix Table C.[23] Consistent with previous findings, local sex ratio has a positive effect on saving rates, although the estimated effect is statistically insignificant, as shown in Column 5. In Column 6, we further test the idea that the whole family, including parents and grandparents, would pool resources to help young adults in the family when marriage market pressure intensifies. We allow the sex-ratio variable to interact with age dummies for older people, and find an insignificant, positive effect on their saving rates. These results are broadly consistent with the competitive saving motive, but the effects of demographic changes on savings remain robust.

To summarize, we find strong evidence on the age-specific effects of demographic structural changes on household saving rates in China. In particular, households between 51 and 60 years old will increase their saving rates if they have fewer adult children. This result is consistent with the hypothesis that older households save for the purpose of old-age security. The saving rates of middle-aged households between 36 and 50 years old will increase if they have fewer dependent children to raise. Younger households between 26 and 35 years old will save more when they have fewer siblings. These patterns confirm the three hypotheses

[23] The one-child policy is a key determinant of the sex ratio imbalance in China. We consider two determinants of local sex ratios that are unlikely to be affected by local saving rates, following Wei and Zhang (2011). First, the implementation of family planning is local, thus we use regional variations in fertility fine to instrument local sex ratio. Second, ethnic minority groups face less strict birth quota, and they are not uniformly distributed across provinces. This variation provides a second instrument.

posited in the model. These patterns are also robust to additional controls on life-cycle saving pattern and other factors posited in the literature, such as competitive saving motive and precautionary saving motive.

5.4 Robustness Checks

Results in Table 2 indicate that older households save more for their old-age security when they have fewer adult children. Sons are believed to provide more support to parents than daughters, which is one reason why traditional preference for sons is widespread in China; households with more sons would save less if old-age security is the main saving motive. In Column 1 of Table 3, we examine whether the gender composition of children affects household savings by including the proportion of sons interacted with age-interval dummies between age 46 and 60 as additional control variables. The estimated coefficients on age-specific demographic variables have the same sign and similar magnitude as before. Specifically, households aged above 50 are found to save more when they have fewer children, conditional on the gender composition of the children. We find some evidence that households between 46 and 60 years old tend to save less if they have more sons, after controlling for the number of children, although the parameter estimates are not statistically significant. These results reinforce the old-age security motive.

Some support for the precautionary saving motive among Chinese households has been found. Job security (state employment) and social safety net (public spending on social security) are associated with lower (precautionary) saving. Saving for old-age security motive is essentially one type of precautionary saving. When having a child is a substitute for saving, having fewer children is associated with a rise in saving to secure old-age support. Therefore, with job security and social safety net, households may rely less on children for old-age security. In Columns 2 and 3 of Table 3, we test for this implication using interactions between state employment share and the number of adult children, and the interactions between public spending on social security and the number of adult children for households between 46 and 60 years old as additional regressors. The estimated effects of demographic structural changes on saving are robust to these additional controls. The marginal effect of adult children on saving is also lower (in absolute term) for state sector employees and for those enjoying higher social security, although the estimated effects are statistically insignificant. These findings are consistent with the old-age security motive.

One concern is that fertility fines may be correlated with local (and unobserved) demographic, social, and economic conditions that affect saving, and that this correlation would violate the identification assumption. Generally, addressing this problem is very difficult because many of the variables may not be observable or known to researchers. However, we can still address this concern partially by conducting several sensitivity tests.

First, we examine whether the estimated effects of demographic changes on household saving are sensitive to the characteristics of locations. The flexible province dummies in Table 2 should capture most of the differences in social and economic conditions at the local leve. Table 2 shows that the estimated age-specific effects of demographic structure on saving are mostly negative and significant. The magnitude of these effects is very similar to the estimates from specifications without controlling for province dummies.[24]

Second, the spatial and time variations in fertility fines may also be affected by past birth rates. Thus, in Columns 1 to 6 of Table 4, we present the specifications that control for provincial birth rates in the previous year. After controlling for past birth rates, the estimates on age-specific effects of demographic structure on saving remain close to those presented in Table 2. Moreover, the coefficient on birth rates in the previous year is not

[24]One referee raised the concern that in some areas in Guangdong province where family is very valued, the local government may not be very strict with fertility fines, and people also tend to save more. To ensure that our results are not driven by this possibility, we estimate our models excluding observations from Guangdong province from our sample; the estimation results are very similar to those reported in Table 2. As a falsification test, we also apply our identification method to a sample born before 1940 (40 or older in 1979, when the one-child policy was first implemented). Presumably, these households should not be affected by the one-child policy; thus, our identification should not work for them. We find that the effects of fertility fines on the number of children are very small and statistically insignificant in the first-stage regression and the number of children has no negative effects on saving identified in the second-stage regression. The different results from the older sample do not suggest misspecification in our identification strategy.

significantly different from zero.

Another concern is that ethnic minorities may have different saving behavior; thus, the share of minority may be directly correlated with saving rates. To examine whether our results are sensitive to this possibility, we exclude minority from the set of instruments and re-estimate our model. Columns (4) to (6) of Appendix Table C show the first-stage regression results. Appendix Table D presents the second-stage estimation results. The estimated age-specific coefficients on the demographic variables have the same sign and similar magnitude as our baseline estimates presented in Table 2. In addition, when the share of minority is included in the savings equation in specifications (3) to (6) in Appendix Table D, the estimated coefficients are not statistically significant. Thus, we find no evidence that the minority share is directly related to saving, consistent with previous findings in literature (e.g., Wei and Zhang, 2011).

5.5 Implications on Saving Profile Changes

In the first step of our empirical analysis, we estimated the effects of demographic changes on saving (Table 2). Next, we will combine these estimates with trends in the numbers of children ever born, dependent children, and siblings presented in Figures 5 to 7 to conduct a "back-of-the-envelope" calculation on how much the demographic structure changes can account for the upward shift in age-saving profile between 1990 and 2005. For each five-year age group, the point estimates in Table 2 present the marginal effects of the demographic structural changes on household saving. That is, the changes in saving rates in percentage points associated with each additional adult child, dependent child, or sibling. Using information from Figures 5 to 7, we can derive average changes in the numbers of children, dependent children, and siblings induced by population policies and other socioeconomic changes between 1990 and 2005 for each age group. The product of the marginal effects and average demographic changes are the effects of demographic structural changes on age-saving profile shifts between 1990 and 2005 implied by our estimates.

For households headed by individuals with ages between 26 and 30 years, having one more sibling is associated with a 3.04 (Specification 5) to 4.50 (Specification 2) percentage point saving rate decrease depending on different empirical specifications. A decrease in the number of siblings for households between 26 and 30 years old from 3.64 in 1990 to 1.60 in 2005, as illustrated in Figure 7, would lead to an increase in saving rate by 6.20 $[= 3.04 \times (3.64 - 1.60)]$ to 9.17 $[= 4.50 \times (3.64 - 1.60)]$ percentage points, accounting for large portions of the actual increase in the average saving rates from 13.25% in 1990 to 24.89% in 2005. Similarly, for household heads between 31 and 35 years old, having one more sibling is associated with a 3.11 to 4.54 percentage point saving rate decrease. Therefore, the observed decrease of 1.75 siblings for this age cohort from 1990 to 2005 would lead to a 5.44 to 7.95 percentage point saving rate increase, accounting for a significant portion of the actual 10.77 percentage point saving rate increase. The decline in sibling size is also statistically significant for explaining the saving rate increase for households with the age of their heads between 36 and 40 years old in some specifications.

For households headed by individuals with ages between 41 and 45 years, having one more dependent child is associated with a 12.68 to 18.65 percentage point saving rate decrease. Given that the number of dependent children for these households decreased from 1.01 in 1990 to 0.63 in 2005, as illustrated in Figure 6, this factor would lead to higher saving rates by 4.82 to 7.09 percentage points across different specifications. In comparison, the observed average saving rates increased by 5.14 percentage points from 16.03% in 1990 to 21.17% in 2005. Similarly, the decrease in the number of dependent children is also a significant contributor to the rise in saving rate for households headed by individuals with ages between 46 and 50 years.

For households headed by individuals with ages between 51 and 55 years, having one more adult child is associated with a 3.42 to 4.31 percentage point decrease in saving rate. The decrease in the number of adult children from 3.30 in 1990 to 1.54 in 2005, as illustrated in Figure 5, would lead to a 6.02 to 7.59 percentage point increase in saving rate because of reduced old-age support. The lower-bound estimates would account for 92% of the actual saving rate increase (6.02 out of 6.55) from 1990 to 2005, whereas the upper-bound estimates would over-predict the saving increase. Furthermore, for households between 56 and 60 years old, having one more adult child is associated with a 2.77 to 5.51 percentage point decrease in saving rate. A decrease in their fertility from 3.84 to 2.03 would imply a 5.01 to 9.97 percentage point increase in saving rate, accounting for at least 57% of the actual increase.

Table 5 summarizes the overall effects of demographic changes on the U-shaped rise in age-saving profile between 1990 and 2005. Under each age column, Rows (1)–(3) present the estimated effect of a key demographic change on the household saving rate for that specific age group, whereas the last two rows compare the estimated effect resulting from simultaneous changes in all three demographic variables with observed actual change in saving rate. The age-specific marginal effects are based on statistically significant coefficients reported in Specification (6) of Table 2.

From 1990 to 2005, observed saving rate increased by 11.64 percentage points for households between 26 and 30 years of age. During this time period, the number of siblings for these households decreased by 2.04. Because having one fewer sibling is associated with 3.62 percentage points increase in saving rate because of parental care motive, saving rate is predicted to rise by 7.39 percentage points. Similarly for households between 31 and 35 years old, a decline in the number of siblings is associated with 6.34 percentage points increase in saving rate (out of 10.76). For households headed by individuals aged between 36 and 50 years old, changes in the number of dependent children have a significant effect on saving rate. These changes can account for 3.38 (out of 9.81), 4.93 (out of 5.14), and 2.97 (out of 1.94) percentage points rise in the saving rates, respectively, for each 5-year age group. For household heads with age above 50, the number of adult children has a significant effect on their saving rates because of old-age-security concerns. Declines in the number of adult children slightly over-predict the saving rate increases for both household groups of 51-55 and 56-60 years. In short, all three age-specific demographic structural changes have quantitatively important effects on the U-shaped rise in age-saving profile between 1990 and 2005. The last column of Table 5 reports the predicted changes in saving rates for all households and those observed in the data. The total change is calculated from age-specific changes in saving rates weighted by corresponding population shares of specific age groups. Overall, using a simple averaging scheme, demographic changes from 1990 to 2005 can account for a significant portion (5.34 out of 7.37 percentage points) of the household saving rate increase, whereas other socioeconomic factors contributed to the remaining changes in household saving.[25]

The "back of the envelope" calculations need to be interpreted cautiously because they are based on point estimates and simple extrapolation, and the instrumental variable estimator is known to identify only the local average treatment effect (Imbens and Angrist, 1994). Therefore, the quantitative extrapolations are only suggestive. Nevertheless, we qualitatively show that the demographic structural changes can partially capture the overall rise in saving rates and the U-shaped increases of the age-saving profile between 1990 and 2005. In particular, the saving rate of younger households increases with fewer siblings; middle-aged households save more as they have fewer dependent children to support; and older households with a reduced number of adult children also increase their saving rates.

6 Conclusion

In this paper, we have attempted to resolve the Chinese household saving puzzle by postulating and estimating the effects of demographic changes on household savings in China. To this end, we have studied China's population policies, which transformed its demographic

[25] Choukhmane, Coeurdacier, and Jin (2016) find that the one-child policy can account for 30% to 60% of the rise in aggregate saving in China. We have identified a larger effect primarily because we investigate the effect of the overall demographic changes, in stead of the one-child policy *per se*, on household saving. As we have emphasized above, the observed demographic changes are driven by the one-child policy and other population control policies and socioeconomic changes. Like Choukhmane, Coeurdacier, and Jin (2016), our theory assumes that interest rate is not affected by saving. Banerjee et al. (2014) argue that the effect of population policies can potentially be mitigated in a general equilibrium model. We believe that China's institutional environment justifies our assumption as interest rates are kept artificially low and controlled by the government (Allen, Qian, and Gu, 2015).

structures. We exploit the variation in fertility changes for households from several birth cohorts and across provinces to identify the effects of demographic structural changes on saving rates. Results indicate that demographic structural changes have age-specific effects on household saving decisions. When we use the estimated model to investigate the changes in household saving profiles between 1990 and 2005, we find that younger households save more with fewer siblings. Middle-aged households save more when they have fewer dependent children to support. Older households with fewer number of adult children also save more.

As the one-child policy approaches the third generation, the "4-2-1" type of family structure (a family with one child, two parents, and four grandparents) is becoming more pervasive. One unanticipated consequence of population control policies could be the increasing household savings. The present paper provides a new rationale for the relaxation of the one-child policy: removing the birth quota could potentially stimulate household consumption and substantially fuel current domestic demand.

The present study focuses on the effects of demographic change on household saving rate in China. However, several neighboring economies, such as Japan, Korea, and Taiwan, have also experienced rising household saving rates along with a decline in fertility in recent decades. Although these economies did not have stringent population control policies, many of the fundamental forces governing demographic change and household saving decisions are likely to be similar. Existing literature has focused largely on the effects of age structure change and dependency rates on aggregate household saving rate, but did not document the U-shaped life-cycle saving profile as observed in China.[26] Whether the different aspects of demographic change identified in the Chinese context can explain changes in life-cycle saving profiles in other economics remains an important topic for future research.

[26] Studies on Taiwan include Deaton and Paxson (1994); Lee, Mason, and Miller (2000); Tsai, Chu, and Chung (2000); Athukurala and Tsai (2003). Hayashi (1986) and Horioka (1997) studied the high saving rate in Japan, and Park and Rhee (2005) analyzed the relationship between savings and demographic change in Korea.

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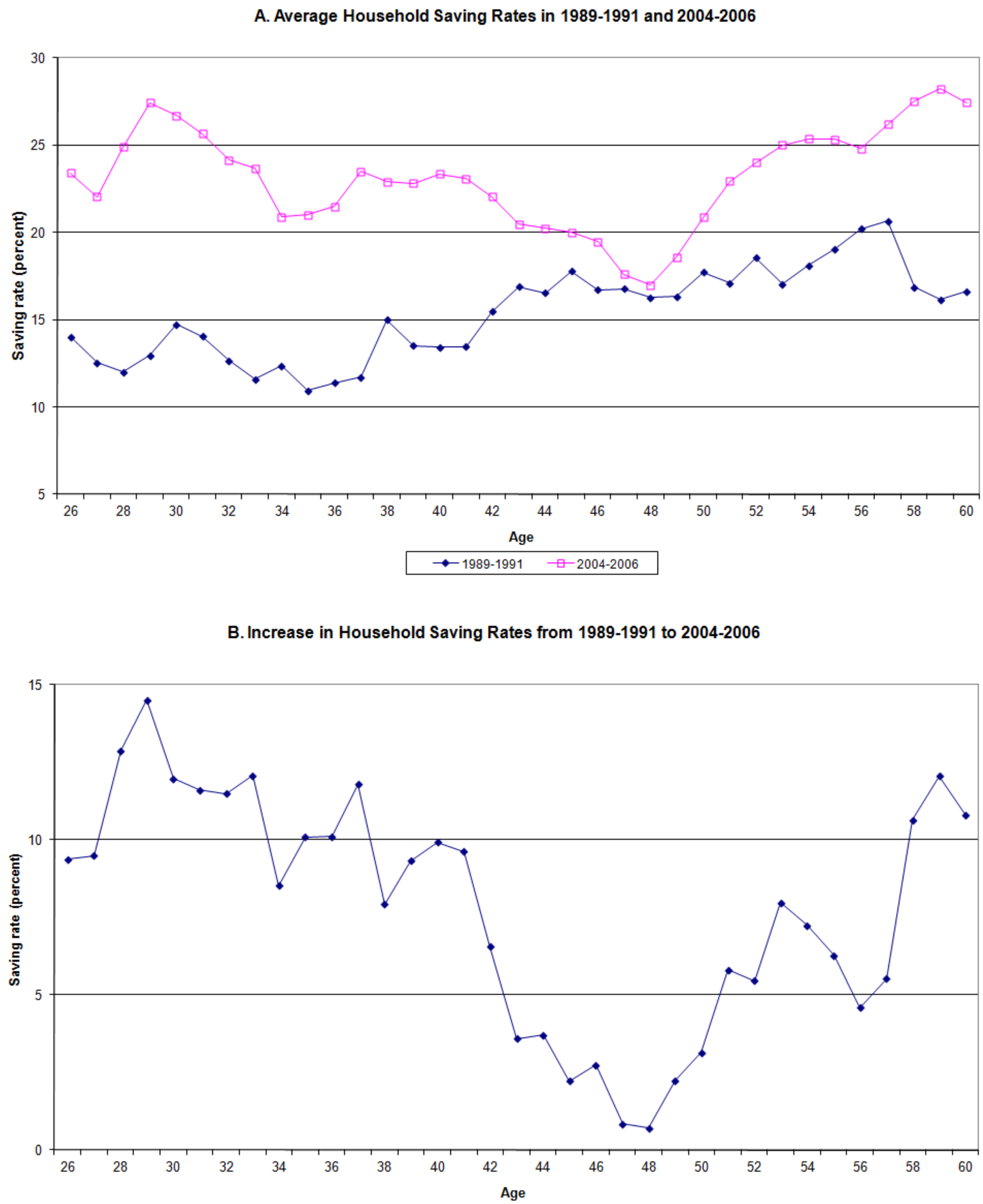
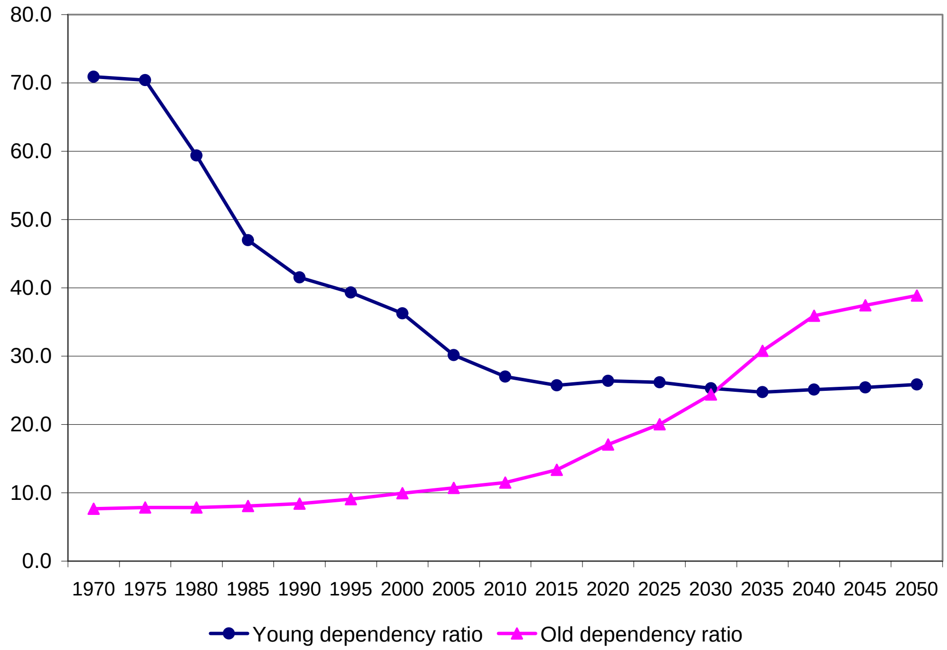


Figure 1. Age-Saving Profiles and Their Changes Over Time



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2008 Revision, http://esa.un.org/unpp.

Figure 2. China's Long-Term Population Trends: 1970 to 2050

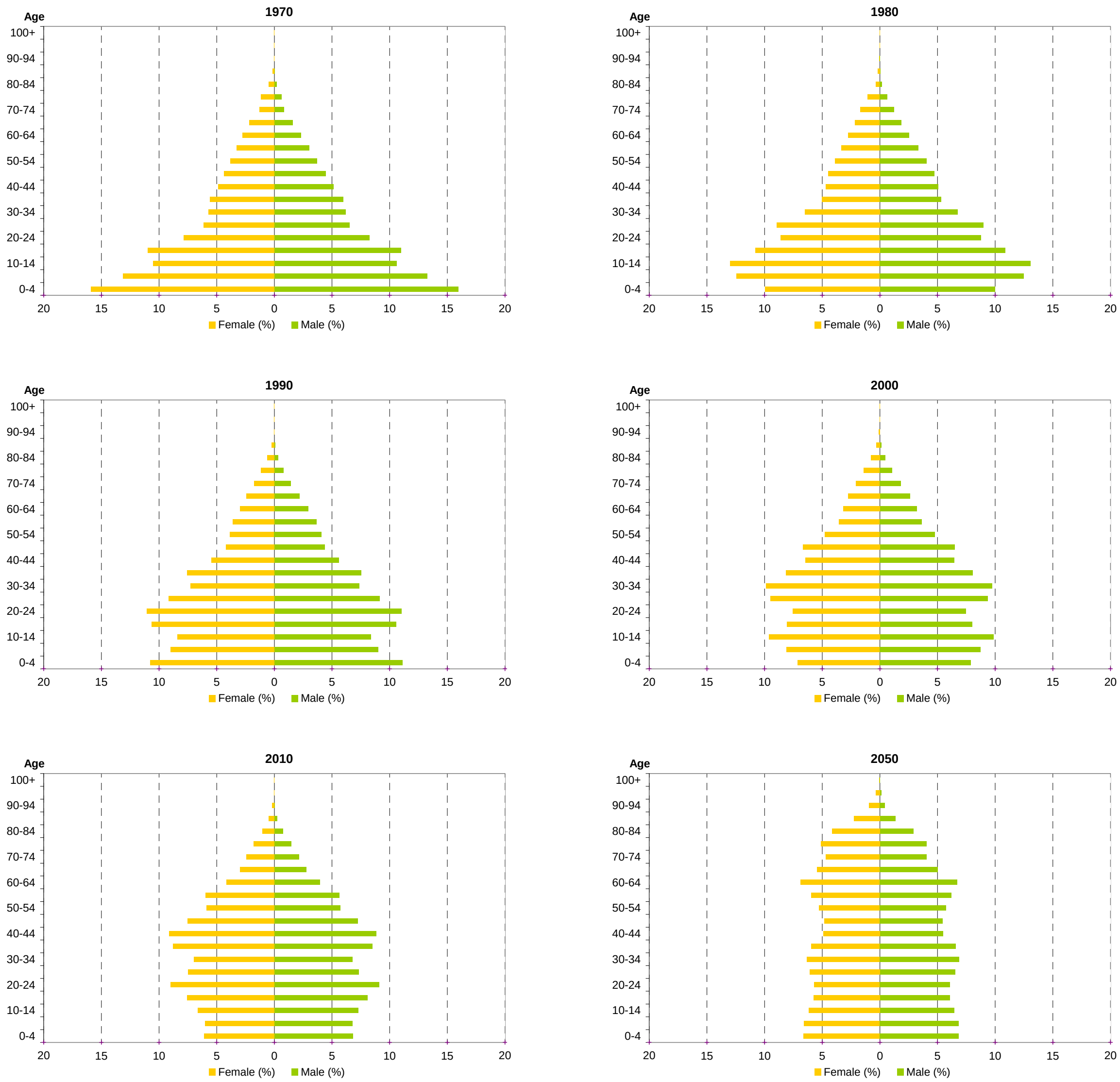


Figure 3. Age Distribution of the Chinese Population: 1970 to 2050

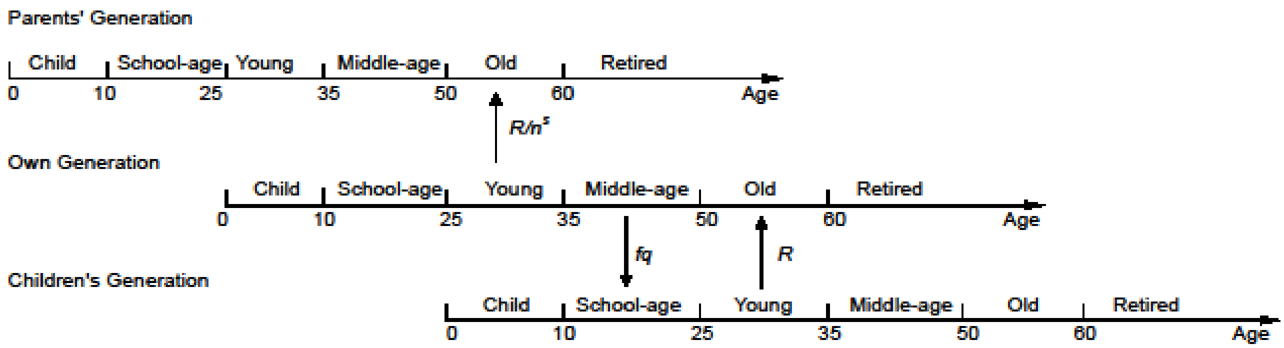


Figure 4. Inter-Generational Links

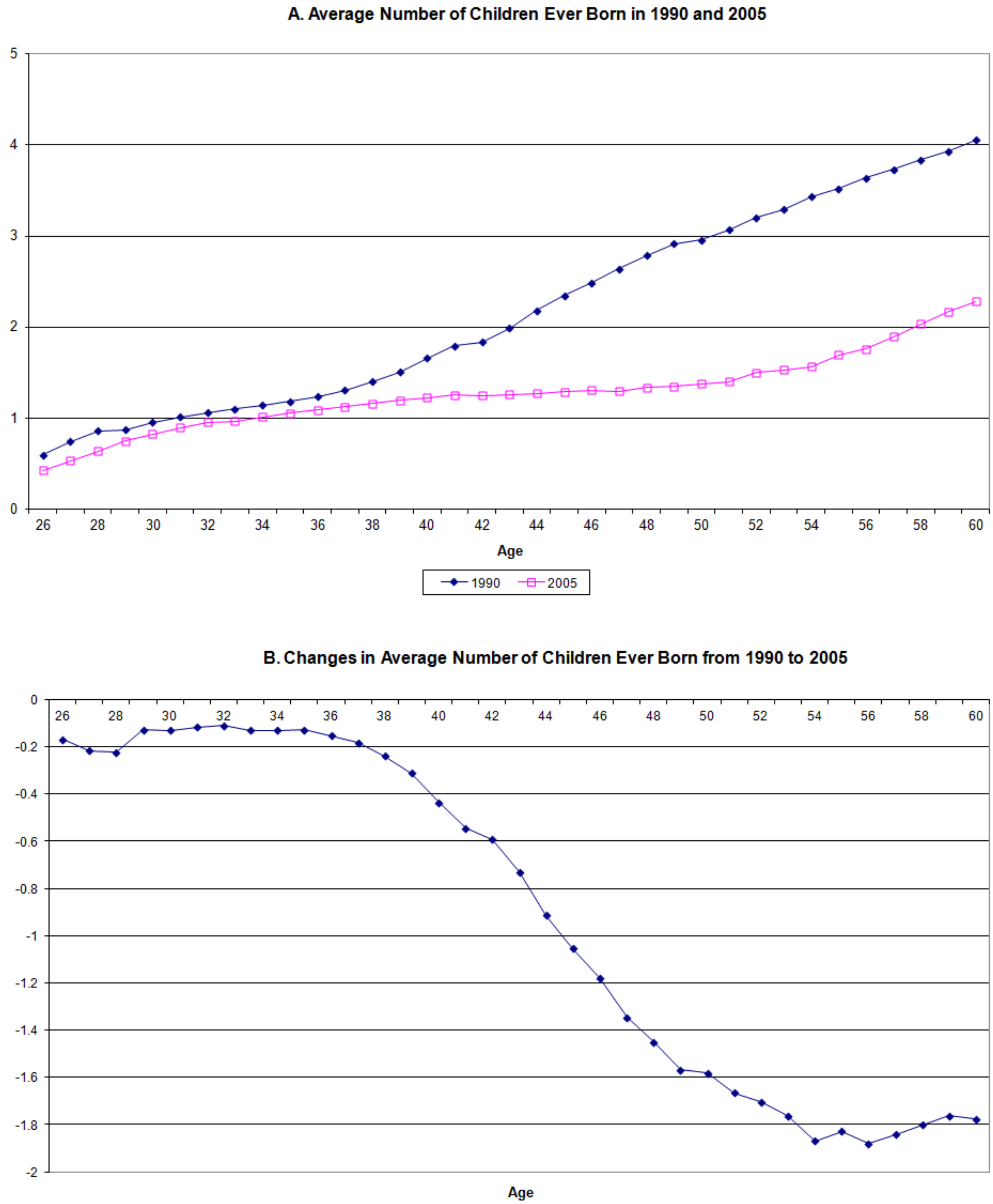


Figure 5. Average Number of Children Profiles and Their Changes Over Time

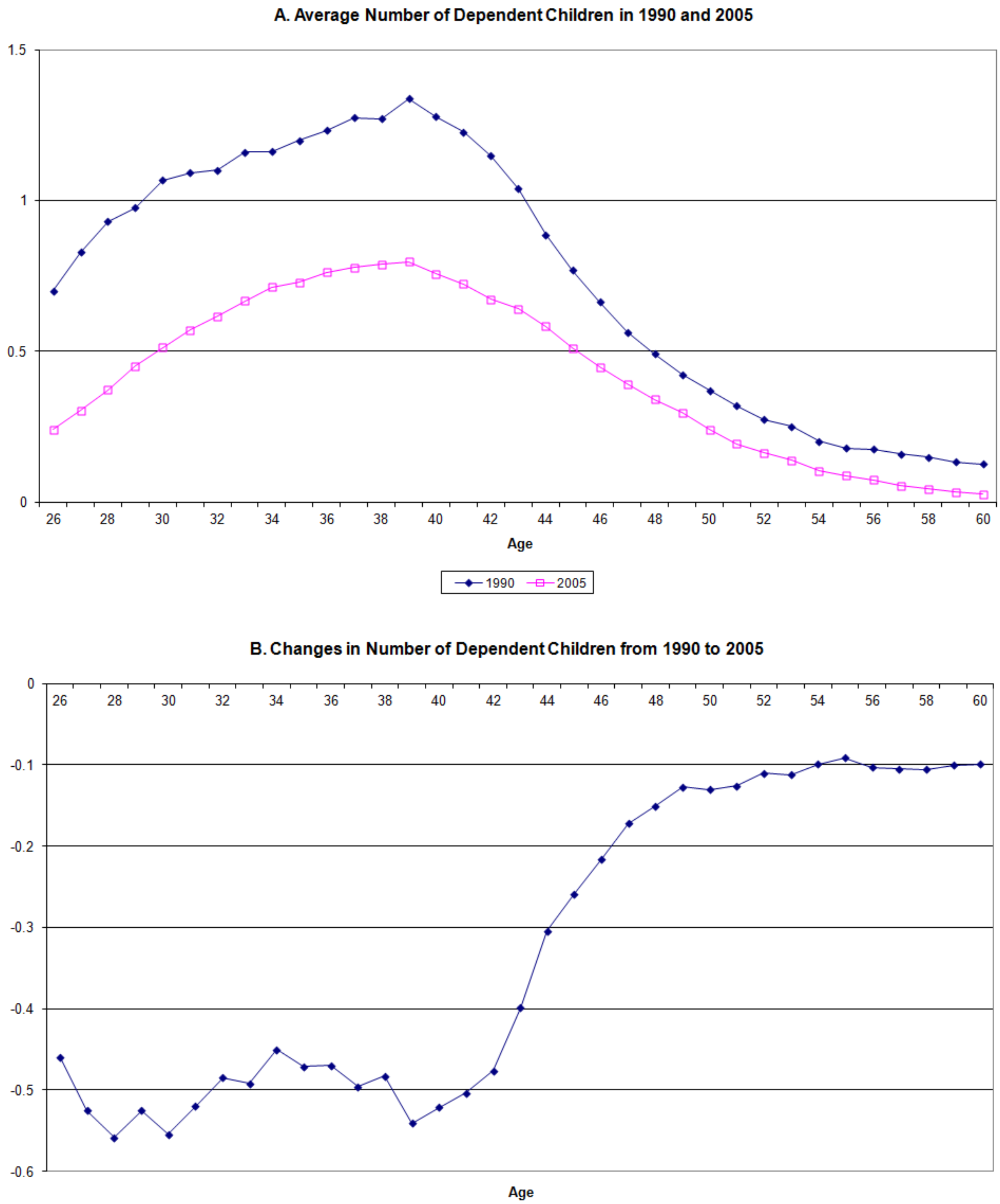


Figure 6. Number of Dependent Children Profiles and Their Changes Over Time

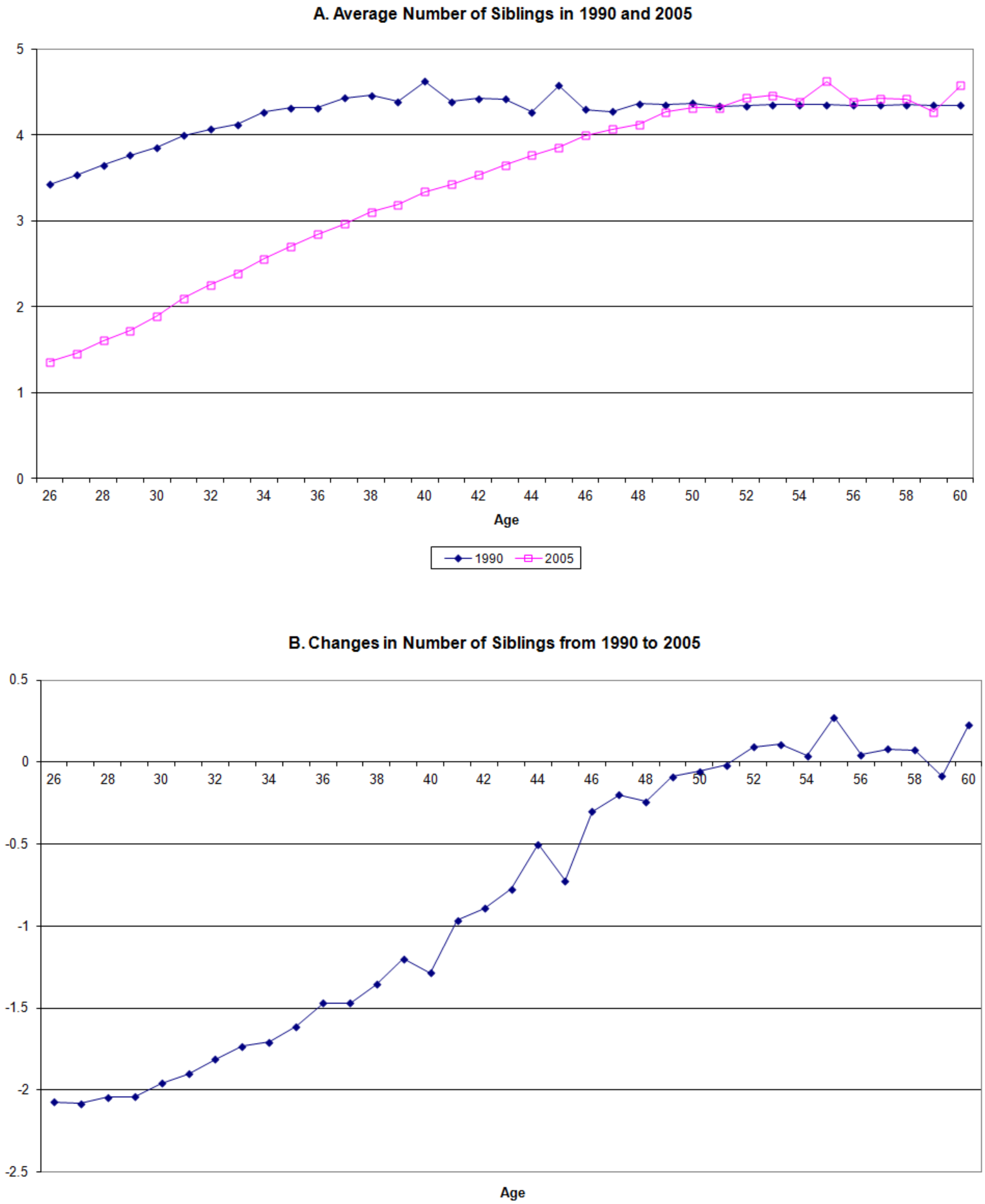


Figure 7. Number of Siblings Profiles and Their Changes Over Time

Table 1. Descriptive Statistics

Variables	1990	2005
Saving rates	16.07	21.47
	(5.33)	(6.05)
Nnumber of children ever born	1.99	1.22
	(1.04)	(0.45)
Number of boys ever born	1.03	0.64
	(0.53)	(0.23)
Number of girls ever born	0.96	0.58
	(0.50)	(0.22)
Number of dependent children	0.57	0.40
	(0.34)	(0.28)
Number of siblings	4.01	3.17
	(0.55)	(1.07)
Proportion of people having at least high school education	36.83	52.89
	(16.72)	(18.42)
Life expectancy	70.17	73.14
	(2.52)	(2.01)
Proportion of state employees	80.98	46.63
	(12.32)	(18.66)
Government spending on social security per person	7.02	74.46
(in 1990 yuan)	(4.79)	(55.29)
Sex ratio for age cohorts 7-21	104.35	112.76
	(2.94)	(6.02)
Fine/income ratio*	1.24	3.25
	(0.57)	(1.38)
Proportion of minorities	2.43	3.55
	(2.56)	(3.61)

* Fine/income ratio is the ratio between fertility fine and annual household income, taken from Ebenstein (2010).

Table 2. Age-Specific Effects of Demographic Structure on Saving

	(1)	(2)	(3)	(4)	(5)	(6)
No. of adult children						
(age 46-50) x Adult children	-1.653	-1.208	-1.033	-1.422	-0.751	0.355
	(1.205)	(1.123)	(0.881)	(1.697)	(1.920)	(1.762)
(age 51-55) x Adult children	-3.869***	-3.612**	-3.416***	-4.066**	-3.513*	-4.309**
	(1.030)	(1.115)	(0.870)	(1.355)	(1.475)	(1.671)
(age 56-60) x Adult children	-2.769**	-3.900***	-3.912***	-4.937***	-4.470***	-5.514***
	(0.980)	(0.920)	(0.793)	(1.092)	(1.159)	(1.169)
No. of dependent children						
(age 36-40) x Dep. children	-2.505	-5.571***	-6.881***	-7.438*	-6.877*	-6.726*
	(2.561)	(1.422)	(1.599)	(2.952)	(3.438)	(2.711)
(age 41-45) x Dep. children	-18.646***	-18.368***	-16.354***	-15.960**	-14.108*	-12.684*
	(2.019)	(4.486)	(3.591)	(5.434)	(5.765)	(5.381)
(age 46-50) x Dep. children	-23.141***	-22.023***	-21.128**	-20.157***	-19.998***	-18.661***
	(6.155)	(4.694)	(7.021)	(5.225)	(5.478)	(3.400)
No. of Siblings						
(age 26-30) x Sibling	-4.428***	-4.497***	-3.981***	-3.382*	-3.041*	-3.624*
	(0.421)	(0.310)	(1.089)	(1.474)	(1.509)	(1.540)
(age 31-35) x Sibling	-3.973***	-4.536***	-3.890***	-3.466***	-3.107**	-3.617**
	(0.607)	(1.022)	(0.899)	(1.048)	(1.167)	(1.151)
(age 36-40) x Sibling	-2.871***	-2.521**	-1.446	-1.060	-0.875	-1.037
	(0.704)	(0.903)	(0.839)	(1.242)	(1.294)	(1.328)
Age		9.180	7.647	6.852	6.202	9.102*
		(5.875)	(5.196)	(3.787)	(3.468)	(3.828)
Age squared		-0.229	-0.191	-0.172*	-0.158	-0.224**
		(0.135)	(0.121)	(0.087)	(0.081)	(0.083)
Age cubic		0.002	0.002	0.001*	0.001*	0.002**
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)

Expected future earnings			-0.116	-0.267	-0.325	-0.133
			(0.312)	(0.250)	(0.249)	(0.220)
Share of high school and above			0.101	0.116	0.108	0.115
			(0.073)	(0.067)	(0.062)	(0.060)
Life expectancy			-0.104	0.133	0.301	-0.032
			(0.484)	(0.189)	(0.226)	(0.194)
Share of state employment				-0.070	-0.069	-0.071
				(0.050)	(0.044)	(0.045)
Government spending on social security				-0.037*	-0.041*	-0.038*
				(0.018)	(0.020)	(0.019)
Sex ratio					0.262	
					(0.291)	
Sex ratio x (age 51-55)						0.069
						(0.042)
Sex ratio x (age 56-60)						0.103
						(0.065)
Adjusted R-squared	0.456	0.474	0.487	0.531	0.534	0.544
No. of observations	416	416	416	416	416	416

Note: Robust standard errors clustered at the province and cohort level are in parentheses. All regressions include province dummies and a constant.

*** significant at 1%, ** significant at 5%, * significant at 10%.

Table 3. Additional Evidence on Old-Age Security Motive

	(1)	(2)	(3)
No. of adult children			
(age 46-50) x Adult children	0.395	-3.570	0.468
	(2.061)	(3.043)	(2.218)
(age 51-55) x Adult children	-4.338**	-4.604	-3.727
	(1.502)	(2.350)	(1.958)
(age 56-60) x Adult children	-5.147***	-6.130*	-5.053**
	(0.985)	(2.474)	(1.744)
No. of dependent children			
(age 36-40) x Dep. Children	-7.228*	-6.874	-6.709**
	(3.126)	(3.581)	(2.419)
(age 41-45) x Dep. Children	-16.859*	-12.982*	-13.099*
	(7.233)	(5.753)	(5.932)
(age 46-50) x Dep. Children	-11.309	-14.978***	-19.789***
	(7.731)	(3.770)	(4.721)
No. of Siblings			
(age 26-30) x Sibling	-3.983**	-3.308*	-3.755*
	(1.524)	(1.639)	(1.606)
(age 31-35) x Sibling	-3.999**	-3.358**	-3.771**
	(1.297)	(1.290)	(1.192)
(age 36-40) x Sibling	-1.445	-0.910	-1.168
	(1.259)	(1.351)	(1.231)
Age	7.927	7.631*	9.421**
	(5.022)	(3.584)	(3.561)
Age squared	-0.193	-0.188*	-0.229**
	(0.116)	(0.079)	(0.075)
Age cubic	0.002	0.002**	0.002***
	(0.001)	(0.001)	(0.000)
Expected future earnings	-0.071	-0.132	-0.139
	(0.245)	(0.235)	(0.260)
Share of high school and above	0.111	0.104	0.117
	(0.066)	(0.062)	(0.071)
Life expectancy	-0.132	0.025	-0.106
	(0.254)	(0.177)	(0.218)
Share of state employment	-0.064	-0.086	-0.076
	(0.044)	(0.048)	(0.054)
Government spending on Social security	-0.037	-0.038	-0.043
	(0.020)	(0.019)	(0.030)
Sex ratio x (age 51-55)	0.137*	0.053	0.052*
	(0.067)	(0.056)	(0.024)
Sex ratio x (age 56-60)	0.257*	0.089	0.095
	(0.105)	(0.090)	(0.085)

Proportion of Sons			
(age 46-50) x %Sons	-0.135		
	(0.140)		
(age 51-55) x %Sons	-0.235		
	(0.177)		
(age 56-60) x %Sons	-0.447		
	(0.241)		
Fertility x state employment (% state)			
(age 46-50) x Fertility x % state		0.037	
		(0.023)	
(age 51-55) x Fertility x % state		0.005	
		(0.035)	
(age 56-60) x Fertility x % state		0.007	
		(0.023)	
Fertility x social security			
(age 46-50) x Fertility x social security			0.005
			(0.022)
(age 51-55) x Fertility x social security			0.016
			(0.031)
(age 56-60) x Fertility x social security			0.009
			(0.029)
Adjusted R-squared	0.552	0.549	0.548
No. of observations	416	416	416

Note: Robust standard errors clustered at the province and cohort level are in parentheses. All regressions include province dummies and a constant.
*** significant at 1%, ** significant at 5%, * significant at 10%.

Table 4. Robustness Checks with Previous Birth Rates

	(1)	(2)	(3)	(4)	(5)	(6)
No. of adult children						
(age 46-50) x Adult children	-0.528*	-0.741	-0.964	-1.251	-1.241	0.328
	(0.243)	(1.151)	(1.201)	(1.542)	(1.578)	(1.619)
(age 51-55) x Adult children	-2.910***	-3.296*	-3.708***	-4.206**	-4.207**	-4.454*
	(0.608)	(1.631)	(0.978)	(1.415)	(1.305)	(1.902)
(age 56-60) x Adult children	-2.002***	-3.687**	-4.389***	-5.336***	-5.337***	-5.702***
	(0.542)	(1.170)	(0.923)	(1.120)	(0.985)	(0.922)
No. of dependent children						
(age 36-40) x Dep. children	-3.541	-6.503	-6.292	-5.148	-5.160	-4.756
	(6.481)	(6.088)	(3.901)	(3.218)	(3.402)	(3.520)
(age 41-45) x Dep. children	-15.205***	-16.685***	-16.084***	-14.726**	-14.761**	-11.850*
	(0.978)	(3.786)	(2.428)	(4.653)	(4.589)	(5.016)
(age 46-50) x Dep. children	-23.420***	-22.453***	-21.678***	-19.839***	-19.929***	-18.536***
	(6.071)	(4.403)	(5.959)	(5.328)	(5.110)	(4.855)
No. of Siblings						
(age 26-30) x Sibling	-3.581***	-4.264**	-3.770***	-2.970*	-2.991**	-3.232*
	(0.585)	(1.362)	(0.632)	(1.454)	(1.158)	(1.571)
(age 31-35) x Sibling	-3.271***	-4.253***	-3.763***	-3.111**	-3.127***	-3.273**
	(0.519)	(0.693)	(0.677)	(1.022)	(0.936)	(1.072)
(age 36-40) x Sibling	-2.012	-2.018	-1.594	-1.384	-1.392	-1.304
	(1.197)	(1.375)	(1.009)	(1.092)	(0.995)	(1.246)
Age		8.668*	7.368	5.967*	5.995*	8.016**
		(3.820)	(4.563)	(2.751)	(3.017)	(2.679)
Age squared		-0.219*	-0.186	-0.154*	-0.154*	-0.200***
		(0.089)	(0.106)	(0.065)	(0.071)	(0.056)
Age cubic		0.002**	0.002	0.001**	0.001*	0.002***

	(1)	(2)	(3)	(4)	(5)	(6)
		(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Expected future earnings			-0.269	-0.438	-0.437	-0.296
			(0.341)	(0.295)	(0.304)	(0.248)
Share of high school and above			0.085	0.102	0.102	0.107
			(0.067)	(0.070)	(0.060)	(0.060)
Life expectancy			-0.877	-0.636	-0.580	-0.667
			(1.061)	(0.423)	(0.976)	(0.362)
Share of state employment				-0.078	-0.078*	-0.079
				(0.047)	(0.040)	(0.049)
Government spending on social security				-0.032	-0.033	-0.034
				(0.022)	(0.025)	(0.024)
Sex ratio					0.032	
					(0.443)	
Sex ratio x (age 51-55)						0.063
						(0.040)
Sex ratio x (age 56-60)						0.090
						(0.065)
Birth rates in previous year	-0.156	-0.045	-0.346	-0.303	-0.274	-0.242
	(0.198)	(0.374)	(0.516)	(0.283)	(0.478)	(0.273)
Adjusted R-squared	0.470	0.486	0.505	0.547	0.547	0.558
No. of observations	416	416	416	416	416	416

Note: Robust standard errors clustered at the province and cohort level are in parentheses. All regressions include province dummies and a constant.

*** significant at 1%, ** significant at 5%, * significant at 10%.

Table 5. Effects of Demographic Structure Change on Saving Rates between 1990 and 2005

	Age groups							
	26-30	31-35	36-40	41-45	46-50	51-55	56-60	All ages
Number of adult children								
Changes between 1990 and 2005						-1.767	-1.813	
Marginal effect						-4.309	-5.514	
Number of children effect (1)						7.614	9.997	
Number of dependent children								
Changes between 1990 and 2005			-0.502	-0.389	-0.159			
Marginal effect			-6.726	-12.684	-18.661			
Number of dependent children effect (2)			3.376	4.934	2.967			
Number of siblings								
Changes between 1990 and 2005	-2.039	-1.753						
Marginal effect	-3.624	-3.617						
Number of siblings effect (3)	7.389	6.341						
Total effect on saving rate (1)+(2)+(3)	7.389	6.341	3.376	4.934	2.967	7.614	9.997	5.343
Actual changes in saving rate	11.641	10.762	9.812	5.142	1.935	6.551	8.726	7.369

Appendix Table A. Age-Specific Effects of Demographic Structure on Saving, with All Age Interactions

	(1)	(2)	(3)	(4)	(5)	(6)
No. of adult children						
(age 26-30) x Adult children	-0.083	3.017	4.115	-2.959	-4.381	-1.463
	(10.708)	(9.397)	(9.128)	(11.002)	(12.121)	(10.656)
(age 31-35) x Adult children	9.026	6.963	6.899	3.154	1.506	3.671
	(6.153)	(8.229)	(7.233)	(5.836)	(8.400)	(5.794)
(age 36-40) x Adult children	4.338	5.316	4.688	2.323	1.059	3.586
	(3.832)	(4.708)	(4.912)	(4.389)	(5.842)	(3.945)
(age 41-45) x Adult children	-2.224	-1.440	-1.713	-4.278	-5.976	-3.149
	(3.416)	(3.637)	(3.150)	(4.389)	(6.827)	(5.215)
(age 46-50) x Adult children	-0.143	0.411	0.070	-0.934	-1.873	-0.209
	(1.248)	(1.227)	(2.546)	(3.207)	(4.825)	(3.077)
(age 51-55) x Adult children	-3.778**	-3.720**	-4.620***	-6.062**	-6.998*	-5.403*
	(1.254)	(1.280)	(1.401)	(2.018)	(3.411)	(2.323)
(age 56-60) x Adult children	-3.411	-3.787	-4.050	-5.783*	-6.677	-6.242*
	(2.467)	(2.351)	(3.286)	(2.750)	(3.699)	(2.815)
No. of dependent children						
(age 26-30) x Dep. children	3.112	-10.847	-10.978	-7.534	-10.744	-11.888
	(12.504)	(11.911)	(10.416)	(15.194)	(15.621)	(14.041)
(age 31-35) x Dep. children	-22.718	-27.271	-24.382	-24.764	-26.766	-26.917
	(18.437)	(23.053)	(22.775)	(16.370)	(18.453)	(16.968)
(age 36-40) x Dep. children	-10.045	-19.670	-18.414	-20.804	-23.196	-23.547*
	(7.369)	(13.087)	(11.479)	(12.310)	(12.890)	(11.092)
(age 41-45) x Dep. children	-9.104	-16.375	-12.461	-13.556	-15.870	-16.597
	(12.306)	(13.581)	(12.101)	(12.723)	(14.945)	(13.632)
(age 46-50) x Dep. children	-16.043*	-22.458**	-19.675*	-23.208**	-26.238*	-27.618**
	(6.531)	(8.413)	(7.849)	(8.883)	(10.409)	(10.447)
(age 51-55) x Dep. children	-17.553**	-16.559	-18.188	-20.314	-24.210	-28.208
	(6.734)	(13.643)	(12.859)	(14.852)	(16.435)	(19.992)

(age 56-60) x Dep. children	-55.923	-46.872	-46.446	-46.322	-46.804	-29.063
	(87.330)	(86.446)	(88.391)	(41.847)	(42.810)	(57.428)
No. of siblings						
(age 26-30) x Sibling	-5.223**	-3.577**	-3.462**	-3.326	-3.245	-3.140
	(1.831)	(1.355)	(1.143)	(2.231)	(2.387)	(2.111)
(age 31-35) x Sibling	-1.301	-0.960	-1.135	-1.055	-1.252	-1.105
	(2.561)	(2.990)	(2.847)	(2.723)	(3.356)	(3.010)
(age 36-40) x Sibling	-2.750*	-2.016	-1.521	-1.324	-1.503	-1.216
	(1.085)	(1.243)	(1.785)	(2.136)	(2.504)	(2.197)
(age 41-45) x Sibling	-1.020	-0.467	-1.058	-1.007	-1.035	-0.497
	(2.185)	(2.546)	(2.346)	(1.939)	(2.167)	(1.661)
(age 46-50) x Sibling	-1.598	-0.937	-1.383	-1.562	-1.747	-0.546
	(1.280)	(2.127)	(1.929)	(1.481)	(1.728)	(2.012)
(age 51-55) x Sibling	0.508	1.067	1.095	0.950	0.844	1.531
	(1.341)	(2.407)	(2.456)	(2.082)	(2.487)	(3.254)
(age 56-60) x Sibling	1.264	1.497	0.847	0.771	0.622	-1.177
	(1.193)	(2.559)	(2.944)	(2.772)	(3.438)	(1.959)
Age		13.900	11.462	13.830*	16.940*	18.237**
		(10.805)	(10.048)	(7.046)	(8.095)	(5.560)
Age squared		-0.331	-0.271	-0.323	-0.390*	-0.426**
		(0.251)	(0.233)	(0.172)	(0.191)	(0.133)
Age cubic		0.003	0.002	0.002	0.003*	0.003**
		(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Expected future earnings			-0.130	-0.260	-0.233	-0.141
			(0.431)	(0.268)	(0.306)	(0.292)
Share of high school and above			0.108	0.125*	0.137*	0.120*
			(0.080)	(0.060)	(0.069)	(0.057)
Life expectancy			-0.381	0.041	-0.069	-0.004
			(0.775)	(0.466)	(0.570)	(0.592)

Share of state employment				-0.051	-0.048	-0.041
				(0.051)	(0.051)	(0.050)
Government spending on social security				-0.050	-0.051	-0.050
				(0.029)	(0.031)	(0.028)
Sex ratio					-0.261	
					(0.488)	
Sex ratio x (age 51-55)						0.036
						(0.133)
Sex ratio x (age 56-60)						0.156
						(0.152)
Adjusted R-squared	0.490	0.503	0.516	0.565	0.566	0.573
No. of observations	416	416	416	416	416	416

Note: Standard errors are in parentheses.
*** significant at 1%, ** significant at 5%, * significant at 10%.

Appendix Table B. Age-Specific Effects of Demographic Structure on Saving: OLS Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
No. of adult children						
(age 46-50) x Adult children	-1.893*	-1.158	-1.137	-1.366	-1.182	0.180
	(0.789)	(0.808)	(1.046)	(1.062)	(1.106)	(1.131)
(age 51-55) x Adult children	-2.790***	-2.272***	-2.224**	-2.765***	-2.583**	-3.162***
	(0.414)	(0.498)	(0.755)	(0.779)	(0.836)	(0.919)
(age 56-60) x Adult children	-1.959***	-2.965***	-2.990***	-3.700***	-3.495***	-3.875***
	(0.350)	(0.573)	(0.800)	(0.806)	(0.875)	(0.835)
No. of dependent children						
(age 36-40) x Dep. children	5.291	5.188	4.495	2.473	2.560	3.374
	(4.557)	(4.598)	(4.573)	(4.468)	(4.474)	(4.412)
(age 41-45) x Dep. children	-13.876***	-11.640***	-7.588**	-7.991**	-7.590**	-4.839
	(1.417)	(1.797)	(2.682)	(2.781)	(2.860)	(2.896)
(age 46-50) x Dep. children	-16.983***	-14.176***	-11.631**	-12.600**	-12.575**	-10.233*
	(3.982)	(4.066)	(4.272)	(4.096)	(4.100)	(4.120)
No. of Siblings						
(age 26-30) x Sibling	-3.617***	-4.222***	-2.662**	-2.293*	-2.206*	-2.047*
	(0.380)	(0.512)	(0.923)	(0.924)	(0.936)	(0.915)
(age 31-35) x Sibling	-3.278***	-3.736***	-2.116*	-1.936*	-1.857*	-1.740*
	(0.316)	(0.433)	(0.825)	(0.828)	(0.839)	(0.821)
(age 36-40) x Sibling	-4.074***	-4.054***	-2.417*	-1.877	-1.836	-1.714
	(1.077)	(1.058)	(1.172)	(1.126)	(1.129)	(1.116)
Age		6.524*	2.248	2.112	2.013	3.423
		(2.927)	(3.357)	(3.245)	(3.251)	(3.232)
Age squared		-0.177*	-0.074	-0.069	-0.067	-0.096
		(0.069)	(0.080)	(0.077)	(0.077)	(0.077)
Age cubic		0.002**	0.001	0.001	0.001	0.001
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)

Expected future earnings			-0.535	-0.654*	-0.641*	-0.701*
			(0.313)	(0.302)	(0.303)	(0.301)
Share of high school and above			0.092**	0.093**	0.088**	0.112***
			(0.030)	(0.029)	(0.030)	(0.030)
Life expectancy			-0.282	-0.375	-0.366	-0.458
			(0.326)	(0.334)	(0.334)	(0.331)
Share of state employment				-0.075***	-0.068**	-0.076***
				(0.018)	(0.022)	(0.018)
Government spending on social security				-0.036***	-0.035***	-0.035***
				(0.009)	(0.009)	(0.009)
Sex ratio					0.052	
					(0.085)	
Sex ratio x (age 51-55)						0.069**
						(0.022)
Sex ratio x (age 56-60)						0.087**
						(0.027)
Adjusted R-squared	0.408	0.428	0.443	0.489	0.488	0.503
No. of observations	416	416	416	416	416	416

Note: Robust standard errors clustered at the province and cohort level are in parentheses. All regressions include province dummies and a constant.
*** significant at 1%, ** significant at 5%, * significant at 10%.

Appendix Table C. First-Stage Regression Results

	IV Set: Fertility Fines and Minority Share			IV Set: Fertility Fines only		
	No. of Adult Children	No. of Dependent Children	Sex Ratio	No. of Adult Children	No. of Dependent Children	Sex Ratio
	(1)	(2)	(3)	(4)	(5)	(6)
Fine x cohort 1945-1949	-0.357***	-0.006		-0.346***	-0.003	
	(0.021)	(0.008)		(0.020)	(0.008)	
Fine x cohort 1950-1954	-0.358***	-0.009		-0.348***	-0.006	
	(0.019)	(0.007)		(0.019)	(0.007)	
Fine x cohort 1955-1959	-0.295***	-0.028***		-0.286***	-0.026***	
	(0.019)	(0.007)		(0.019)	(0.007)	
Fine x cohort 1960-1964	-0.223***	-0.022**		-0.213***	-0.020***	
	(0.019)	(0.007)		(0.019)	(0.007)	
Fine x cohort 1965-1969	-0.171***	-0.050***		-0.157***	-0.047***	
	(0.021)	(0.008)		(0.020)	(0.008)	
Fine x cohort 1970-1974	-0.138***	-0.090***		-0.120***	-0.086***	
	(0.021)	(0.008)		(0.020)	(0.008)	
Fine x cohort 1975-1979	-0.136***	-0.095***		-0.119***	-0.091***	
	(0.023)	(0.009)		(0.023)	(0.008)	
Fine			2.020***			1.120***
			(0.209)			(0.207)
Minority	0.015**	0.004	-0.922***			
	(0.006)	(0.002)	(0.096)			
Age	0.296*	0.890***		0.278**	0.886***	
	(0.131)	(0.049)		(0.132)	(0.049)	
Age squared	-0.006	-0.020***		-0.005*	-0.020***	
	(0.003)	(0.001)		(0.003)	(0.001)	
Age cube	0.000*	0.000***		0.000*	0.000***	
	(0.000)	(0.000)		(0.000)	(0.000)	
F-statistics for Ivs	87.81***	28.80***	64.21***	98.01***	32.38***	29.37***
Observations	416	416	416	416	416	416
Adjusted R-squared	0.854	0.846	0.234	0.852	0.845	0.064

Note: Standard errors are in parentheses.
*** significant at 1%, ** significant at 5%, * significant at 10%.

Appendix Table D. Age-Specific Effects of Demographic Structure on Saving: Fertility Fines as IVs

	(1)	(2)	(3)	(4)	(5)	(6)
No. of adult children						
(age 46-50) x Adult children	-1.668	-1.256	-1.061	-1.607	-0.372	0.157
	(1.218)	(1.195)	(0.918)	(1.680)	(2.869)	(1.842)
(age 51-55) x Adult children	-3.928***	-3.714**	-3.439***	-4.083**	-2.940	-4.483**
	(1.041)	(1.143)	(0.878)	(1.360)	(2.264)	(1.596)
(age 56-60) x Adult children	-2.811**	-3.941***	-3.836***	-4.803***	-3.779*	-5.269***
	(0.994)	(0.973)	(0.703)	(1.040)	(1.805)	(0.977)
No. of dependent children						
(age 36-40) x Dep. children	-2.488	-5.430**	-6.613***	-7.151*	-6.145	-6.432*
	(3.189)	(1.752)	(1.742)	(2.793)	(4.528)	(2.590)
(age 41-45) x Dep. children	-18.812***	-18.642***	-16.567***	-16.088**	-12.299	-12.605*
	(2.068)	(4.425)	(3.527)	(5.333)	(8.064)	(5.422)
(age 46-50) x Dep. children	-23.555***	-22.571***	-21.597***	-19.916***	-19.035*	-18.155***
	(5.936)	(4.107)	(6.434)	(5.076)	(8.015)	(3.168)
No. of Siblings						
(age 26-30) x Sibling	-4.474***	-4.506***	-3.995***	-3.282*	-2.496	-3.463*
	(0.390)	(0.319)	(1.124)	(1.600)	(2.200)	(1.592)
(age 31-35) x Sibling	-4.012***	-4.554***	-3.913***	-3.413**	-2.630	-3.504**
	(0.618)	(1.017)	(0.905)	(1.122)	(1.737)	(1.166)
(age 36-40) x Sibling	-2.910***	-2.589**	-1.541	-1.107	-0.666	-1.035
	(0.799)	(0.920)	(0.869)	(1.177)	(1.757)	(1.249)
Age		9.004	7.521	6.658	5.330	8.852*
		(5.772)	(5.054)	(3.611)	(5.213)	(3.757)
Age squared		-0.224	-0.187	-0.165*	-0.135	-0.216**
		(0.133)	(0.117)	(0.083)	(0.121)	(0.082)
Age cubic		0.002	0.002	0.001*	0.001	0.002**
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)

Share of Minority			0.104	0.527	0.421	0.518
			(0.255)	(0.287)	(0.567)	(0.286)
Expected future earnings			-0.088	-0.205	-0.294	-0.086
			(0.324)	(0.251)	(0.370)	(0.221)
Share of high school and above			0.099	0.117	0.104	0.117*
			(0.080)	(0.064)	(0.086)	(0.058)
Life expectancy			-0.165	0.021	0.301	-0.136
			(0.561)	(0.143)	(0.422)	(0.156)
Share of state employment				-0.071	-0.067	-0.073
				(0.049)	(0.077)	(0.045)
Government spending on social security				-0.044*	-0.058	-0.044*
				(0.020)	(0.037)	(0.021)
Sex ratio					0.943	
					(0.887)	
Sex ratio x (age 51-55)						0.072
						(0.038)
Sex ratio x (age 56-60)						0.098
						(0.071)
Adjusted R-squared	0.459	0.476	0.489	0.539	0.550	0.551
No. of observations	416	416	416	416	416	416

Note: Robust standard errors clustered at the province and cohort level are in parentheses. All regressions include province dummies and a constant.
*** significant at 1%, ** significant at 5%, * significant at 10%.