China's Below-Replacement Fertility: Recent Trends and Future Prospects

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Between 1970 and 1990, fertility in China declined from levels of nearly six births per woman to rates slightly above two births (measured by the total fertility rate, TFR). In the period since 1990—the focus of this article—there is consensus that fertility declined further, but debate continues regarding the extent of decline (see contributions in Jiang 1996). Analysts skeptical of reports of very low fertility levels in China, and also Chinese government officials, have argued that unauthorized (out-of-plan) births are systematically underreported (see Zeng 1996; Merli 1998; Merli and Raferty 2000; Merli and Smith 2002; Murphy 2003) and that true fertility levels are higher than those derived from recorded births. However, new data and new estimation methods continue to show very low Chinese birth rates. Census data for 2000 produced an estimated TFR of 1.22 children per woman (for the year November 1999 through October 2000; see National Bureau of Statistics of China (NBS) 2002), and NBS's adjusted estimate for internal use is 1.4 (National Bureau of Statistics 2003 (internal)). Retherford et al. (2005) use census data and own-children estimation to argue that the 1997–2000 TFR in China was around 1.5 children per woman; Cai (2008), also using census data and applying variable-*r* methods, concludes that the 1990–2000 TFR was between 1.5 and 1.6. Once appropriate adjustments are made, China's 2006 Family Planning Survey shows no evidence of fertility increase (Guo 2009). Nevertheless, skepticism remains, both among foreign scholars and among Chinese policymakers, about current fertility levels and likely future trends in China.

In this article, we use survey data collected in 1997 and 2001 to further document recent trends in China's fertility rates. Our evidence from these retrospective birth histories is broadly consistent with evidence from Cai (2008) and Retherford et al. (2005), with NBS analysis of census data, and with Zhang and Zhao's (2006) review of available sources, findings, and their limitations. As a result we conclude that current levels are well below replacement and that the TFR is most likely in the range of 1.4 to 1.6. In addition, we expand on previous analyses by examining cohort patterns of parity-specific birth rates and birth timing. The trajectories for birth cohorts now in their childbearing years suggest that these cohorts will not replace themselves; rather, completed fertility levels for the 1976–80 birth cohorts will likely be 1.7 births per woman.

Because of China's explicit and strictly enforced fertility policy, discussions of fertility in China have focused on policy as the primary determinant of birth rates and thus have isolated discussion of Chinese fertility from broader trends in other low-fertility countries. In the second half of the article, we situate China's low-fertility behavior in relation to other low-fertility regimes and discuss present similarities and differences and likely future scenarios. We structure these discussions around a conceptual model of low fertility that was first proposed by Bongaarts (2001, 2002; see also Hagewen and Morgan 2005; Morgan 2003), a *low-fertility proximate determinants* model. Like the classic proximate determinants fertility model (see Bongaarts and Potter 1983), this framework facilitates analysis of population-level fertility rates by specifying the factors that contribute to observed fertility levels. However, the low-fertility model takes stated fertility goals (intentions or ideals), rather than biological limits, as the "baseline" fertility level. The model posits that observed fertility relative to goals is altered by circumstances or processes that cannot be, or are not, incorporated into stated intentions, that is, unwanted fertility, sex composition of future offspring, infecundity, and so on. We consider sequentially the effect of such factors on contemporary Chinese fertility and contrast them to levels and trends in these same factors in Western low-fertility countries. We conclude by acknowledging considerable uncertainty regarding China's future fertility. Nevertheless, we argue that factors exerting additional downward pressure on fertility are likely to exceed those acting to increase it. We thus forecast continued below-replacement fertility in China—even if there is a relaxation or suspension of the government's family planning program, which currently still imposes strong constraints on the number and timing of births.

Data and methods

Our data come from two surveys organized by the State Family Planning Commission (SFPC) of the Chinese government: the 1997 National Population and Reproductive Health Survey (NPRHS) and the 2001 National Family Planning and Reproductive Health Survey (NFPRHS). Sampling for the 1997 NPRHS used a representative two-stage sampling procedure.[1] The NFPRHS was conducted by the SFPC in August–September 2001, using the same sampling frame as the 1997 survey.[2]

To measure fertility during the 1980s and 1990s, we use retrospective fertility history data provided by 15,213 women from the 1997 survey and by 39,586 women from the 2001 survey. These women were aged 15–49 at the time of each survey. The two datasets were combined and then transformed into a person-year format. Poisson regression was used to compute age-parity-specific fertility rates by year (Schoumaker 2004). Finally, age-specific rates were summed to produce period total fertility rates or cumulative cohort fertility estimates.[3] Methods proposed by Bongaarts and Feeney (1998) were applied to calculate the tempo-effects-adjusted TFR (i.e., TFR′, which adjusts for changing mean age at childbearing at each parity).

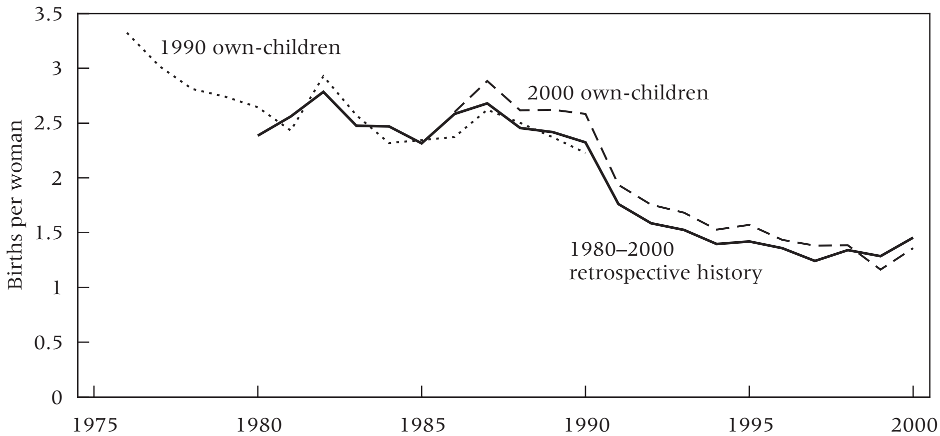
Descriptive results

Period fertility trends

The greatest decline in Chinese birth rates (from TFR levels of approximately 6 to 2.5) occurred before 1980. While not shown here, this pre-1980 decline is well documented and there is broad consensus that it resulted from the joint effects of social and economic changes and the implementation of a national family planning policy (Fraser 1987: 45; Poston 1992; Gu 1996; Tu 2000).

In the solid line in Figure 1, we show 1980–2000 total fertility rates estimated from retrospective birth history data included in the 1997 and 2001 surveys. The two dashed lines show estimates from Retherford et al. (2005) using data and methodology different from ours. Specifically, Retherford and colleagues use census data and estimate fertility levels and trends using own-children methods. They prefer the own-children to birth-history reconstructions, arguing that own-children methods are less sensitive than retrospective history data to underreporting of births. Specifically, because of the retrospective survey focus on births and the purpose and agenda of the data collection agency, the SFPC, many have suspected that these surveys suffer from serious birth underreporting. Own-children methods, in contrast, are based on census reports of persons living in the household and not on fertility reports per se. Thus, errors of omission should be less pronounced. Overall, however, our survey data estimates match the census-based own-children estimates very closely. The two sets of estimates show few consistent differences during the 1980s. Our estimates are slightly lower than the 2000 own-children estimates during most of the 1990s (which is consistent with greater underreporting), but the general trends are the same, and the average absolute difference between the two sets of estimates is small: 0.07 children per woman during the 1990s.[4] Of course, it is possible that once a birth is considered “non-reportable,” it is consistently omitted from all data collection efforts (retrospective reports of births and census household rosters). We discuss this possibility in our conclusion.

FIGURE 1 Estimates of China's period total fertility rate, 1976–2000



SOURCE: Own-children estimates from Retherford et al. (2005). Retrospective history estimates based on authors' calculations from 1997 NPRHS and 2001 NFPRHS. See text for details.

Thus, our survey retrospective history estimates are consistent with census (own-children) estimates (1976–90 and 1986–2000 from 1990 and 2000 censuses, respectively) and with previous descriptions of Chinese fertility (e.g., Feeney and Yuan 1994; Zeng 1996). Specifically, fertility fell sharply in the 1970s, with fluctuations dominating the early-to-mid-1980s. As discussed below, these fluctuations coincided with adjustments to policies relating to marriage and fertility.

Focusing on the post-1980 policy adjustments, we note the strong impact of policy on short-term trends in fertility. For example, as part of the *wan, xi, shao* (*later* marriage, *longer* interval, *fewer* births) policy, the State Family Planning Commission set minimum ages for marriage at 25 for men and 23 for women. These were reduced in 1980 when the National People's Congress adopted a law setting minimum ages for marriage at 22 for men and 20 for women. The legal change resulted in a downward shift in age at marriage and an increase in fertility clearly visible in Figure 1. Later, in 1984, the "open a small hole" adjustment to family planning policy allowed more rural couples to have two children. This policy change created uncertainty regarding the specific policy that was in place for particular locales. No doubt, officials in some local areas used this uncertainty to increase birth quotas. The effects of this policy modification are also apparent in the upturn in fertility in the mid-1980s.

After the "open a small hole" adjustment, it took three to four years for the SFPC to formulate and codify the fertility policy that remains in effect today. Although China's policy is commonly known as the one-child policy, fertility regulations are complex and varied (Gu et al. 2007). By the mid-1990s, regulations are clearly stated for each municipality, but there is variation across municipalities as well as variation based on individual and family characteristics. For the most part, urban couples are restricted to a single child, while couples in most rural areas are permitted a second child if their first child is a girl or if they live in a poor area, among other criteria. Ethnic minorities are also granted exemptions from the one-child policy. In a comprehensive analysis of current provincial-level policies, Gu et al. (2007) calculate that conformity to this patchwork of regulations would result in national fertility rates of approximately 1.5 children per couple.

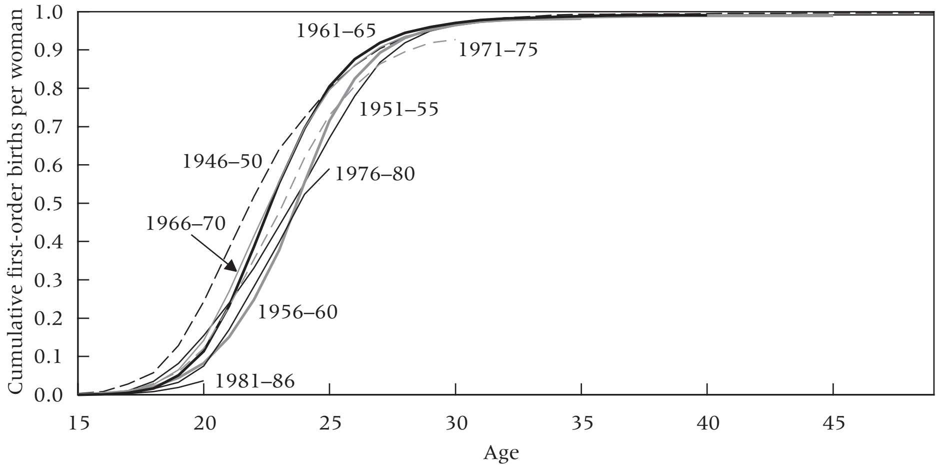
Starting in the late 1980s, we observe a sharp decade-long decline in birth rates that takes Chinese fertility well below replacement levels. The TFR fell below 2.0 around 1991 and continued to decline thereafter, reaching 1.5 children per woman after 1993. Fertility appears to have leveled off in the late 1990s—to about 1.4 based on our data. Data for 2006, if appropriately adjusted, suggest that fertility has remained at this level (Guo 2009). If we assume a correction of 0.1–0.2 children per woman for underreporting[5] of births, our period estimates are in line with Retherford et al. (2005) and Cai (2008). Our primary interest in what follows is in this recent period of below-replacement fertility and the question of its persistence.

Cohort fertility trends

An alternative descriptive approach is to examine the fertility trajectories of actual birth cohorts. In Figures 2, 3, and 4, we show cumulative parity-specific birth rates for seven five-year birth cohorts of women born between 1946 and 1980. These estimates show, by age, the proportion of women who have borne a first, second, or third or higher-order birth. The more recent birth cohorts in these figures had yet to complete a substantial portion of their child-bearing years at the time of the survey. For instance, women born between 1976 and 1980 were between 21 and 25 years old in 2001; they clearly have many years in which to have children or additional children. However, these graphs demonstrate dramatic changes in fertility across the earlier cohorts and are suggestive about the level of completed fertility of these women.

There is virtually no change in the proportion of women having a first birth among the cohorts born in 1970 and earlier (Figure 2). Essentially all women in these cohorts had at least one child. The cumulative proportion having a first birth is high in the later cohorts as well. Approximately 93 percent of women in the 1971–75 birth cohort reported a first child by age 30, compared to 96 percent for the 1966–70 cohort. It is not clear whether the later birth cohort will compensate for this difference by having children in their early 30s, or whether the difference represents a small increase in the proportion of women eventually remaining childless. We return to this issue below.

FIGURE 2 First-order births per woman cumulated over successive ages: Five-year birth cohorts, China, 1946–50 to 1981–86

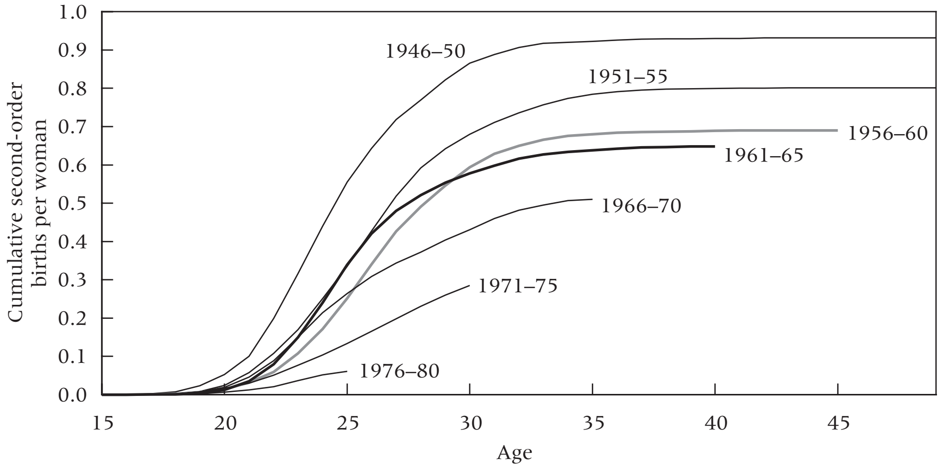


SOURCE: Authors' calculations from 1997 NPRHS and 2001 NFPRHS. See text for details.

The changes in the prevalence and timing of second births are much more pronounced (Figure 3). While 93 percent of women in the 1946–50 birth cohort had at least two children, only 65 percent of women in the 1961–65 cohort had a second birth by age 40. Again, data for the younger cohorts are truncated because these women had not finished childbearing at the survey date. However, given the low fertility rates among women over age 35 in previous cohorts, it seems unlikely that the proportion of women born in 1966–70 having a second child will reach 60 percent. The proportions of women having a second child in the 1970s birth cohorts are far below even those of women born in 1966–70 at comparable ages. Even if some of these births are made up by later fertility, women born in the 1970s will probably have even fewer second births than women currently finishing their childbearing.[6]

Changes in third and higher-order births are also striking. Because Figure 4 combines births of multiple parities, cumulative proportions exceed 1.0 for the earliest cohorts. In contrast to lower-parity births, where change was most apparent for more recent cohorts, the largest reduction in higher parity births was between the 1946–50 and 1951–55 cohorts. Specifically, the cumulative proportion of women having a third or higher birth was over 1.0 for the 1940s birth cohorts and less than 60 percent for women born in the early 1950s. The 1951–55 cohort entered the prime childbearing ages during 1971–75 when the national family planning campaign was just beginning, and most of their childbearing occurred under the "later, longer, fewer" policy. Later cohorts experienced both stricter regulation of childbearing and the effects of rapid economic development (and increased costs of childbearing

FIGURE 3 Second-order births per woman cumulated over successive ages: Five-year birth cohorts, China, 1946–50 to 1976–80

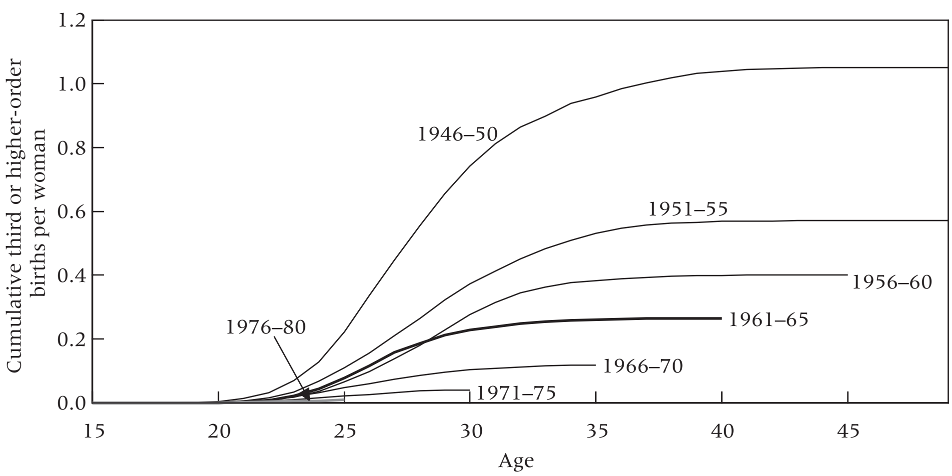


SOURCE: Authors' calculations from 1997 NPRHS and 2001 NFPRHS. See text for details.

and rearing). Third and higher-order birth rates have continued to plummet within subsequent birth cohorts of women.[7]

Based on inspection and extrapolation of these trends, we suggest that mean fertility at birth orders 1, 2, and 3+ will be approximately .95, .55, and .10; implying a mean completed fertility of approximately 1.65 children per

FIGURE 4 Cumulative proportion of women having a third or higher-order birth: Five-year birth cohorts, China, 1946–50 to 1976–80



SOURCE: Authors' calculations from 1997 NPRHS and 2001 NFPRHS. See text for details.

woman (.95 + .55 + .1 = 1.65). Thus, a reasonable estimated range for mean completed fertility for women born in the 1970s and later is 1.6 to 1.7, higher by 0.1 or 0.2 children compared to the period estimates for the 1990s. We account for this difference between completed and period fertility below.

Components of low fertility

To better understand current fertility behavior and future trends, we employ an analytic tool that focuses on period rates and uses a conceptualization of low fertility proposed by Bongaarts and previously used to study aggregate fertility levels in Europe and the United States (e.g., Bongaarts 2001, 2002; Morgan 2003; Hagewen and Morgan 2005; Hayford and Morgan 2008). The goal of this low-fertility proximate determinants model is to separate the multiple factors influencing fertility behavior into a few important parameters. Trends in fertility can then be understood by studying these parameters.

Specifically, current period fertility levels can be decomposed as in equation 1:

$$\mathrm{TFR} = \mathrm{IP} \times F_u \times F_r \times F_s \times F_t \times F_i \times F_c \qquad (1)$$

That is, the total fertility rate (TFR) equals the intended parity (IP, the mean number of births intended) of women in the population increased or de-

TABLE 1 Parameters for the low-fertility proximate determinants model applied to China in 1995–2000, to the United States and Italy in 2000, and to China under selected scenarios in 2020

Row	Description	Symbol	China 1995–2000	International comparisons: US 2000	International comparisons: Italy 2000	China: Future scenarios 2020: 1	2	3
1	Intended parity	IP	1.70	2.20	2.00	1.70	**1.80**	**2.00**
2	Timing effect	F_t	0.87	0.92	0.85	**0.85**	**0.85**	**0.85**
3	Unwanted fertility	F_u	1.01	1.12	1.04	1.01	1.01	1.01
4	Replacement effect	F_r	1.03	1.005	1.005	1.03	1.03	1.03
5	Sex preferences	F_s	1.04	1.02	1.02	1.04	1.04	**1.08**
6	Combined effect	$(F_u \times F_r \times F_s)$	*1.08*	*1.15*	*1.07*	*1.08*	*1.08*	***1.12***
7	Infecundity	F_i	0.96	0.95	0.90	**0.94**	**0.94**	**0.94**
8	Competition	F_c	0.98	0.90	0.75	**0.96**	**0.92**	**0.90**
9	Combined effect	$(F_i \times F_c)$	*0.94*	*0.86*	*0.68*	***0.92***	***0.86***	***0.85***
10	Combined effect	$(F_u \times F_r \times F_s) \times (F_i \times F_c)$	*1.01*	*0.98*	*0.72*	***0.97***	***0.93***	***0.95***
11	Total fertility rate	TFR	1.50	1.99	1.22	**1.41**	**1.43**	**1.62**
12	Adjusted TFR (TFR′)	TFR / F_t	*1.72*	*2.16*	*1.44*	***1.66***	***1.68***	***1.90***

NOTE: Numbers in italics are calculated from other numbers in the table. Values for China in bold are those we predict will differ from values for 1995–2000. See discussion in text.
SOURCES: See text.

creased by a set of parameters that reflect forces that are not factored into women's reports of their childbearing intentions. Model parameters that can inflate period fertility vis-à-vis intended fertility include unwanted fertility (F_u), replacement of children who may have died (F_r), and additional children needed to satisfy strong sex preferences (F_s). These effects all lead to having more children than intended; the parameters are thus greater than 1.0. Other parameters would be expected to take on values less than 1.0 and thus reduce fertility relative to intentions. These factors include postponement of fertility to older ages (F_t), subfecundity and infecundity (F_i), and competition (F_c) with other energy- and time-intensive activities that may lead persons to revise downward their fertility intentions, especially at older ages. We organize our discussion of Chinese fertility around these model parameters. Table 1 accumulates these parameter estimates for subsequent comparison and discussion. Although not all of these parameters are precisely measured, they make clear our assumptions about current levels and future trends.

Intended parity

In the low-fertility proximate determinants model, the baseline level of fertility is set by intended parity, with other terms augmenting or attenuating this mean number of intended births. We briefly address two issues: what is the concept represented by IP and how do we measure it? First, the IP concept is, like the TFR, a period measure. Specifically, the TFR can be interpreted as the mean number of births a woman would have if she experienced contemporary fertility rates throughout her reproductive lifetime. In parallel, IP is the mean intended births (or the desired family size) that characterize a population in a given period. In the absence of other influences represented in the model, we posit that TFR=IP, or contemporary fertility rates reflect the current intent/demand for children.

Second, measurement of IP needs to be contemporary or period specific, i.e., "given the way things are now, how many children should a woman have?" or "given the situation today, how many children would you intend?" The measurement needs to be tied to intended childbearing under current conditions.[8] The Chinese data used here do not ask the precise question one would have hoped for. Rather the 2001 survey asked: " in your opinion, the ideal number of children in a family is _____?" Thus, the available measure of fertility preferences is a generalized preference and, if aggregated, provides a measure of normative family size in this social context. Using this question, women's average intended family size is 1.70 children[9]—in approximate conformity with the cohort projections of completed fertility above.

In the Chinese context, one might argue that intended (or ideal) parity is irrelevant—in other words, women's stated fertility preferences simply restate current government regulations. Admittedly, Chinese women know well the constraints under which they live, and their intentions and ideals acknowledge the constraints imposed by current fertility policy. But we argue that this is not unlike the way in which American women's fertility preferences might take into account the high predicted cost of children's education, or Italian women's intentions might reflect, albeit possibly very poorly, the difficulty of combining work and childbearing. A very large proportion of women in other countries report ideals/intentions for two children. Two children as a normative target is prominent in many contexts.

Ideal fertility well below 2.0 (i.e., 1.7 in 2001) marks a major difference between China and Western low-fertility countries (see Hagewen and Morgan 2005: Figure 1). Most countries for which we have data on fertility ideals/intentions show levels of 2.0 or slightly above (illustrated by the United States and Italy in Table 1, row 1; see Bongaarts 2002; Morgan 2003). As a possible exception, Goldstein and colleagues (2003) point to evidence of recent declines to below-replacement fertility ideals in German-speaking parts of Europe—a change they interpret as portending very low future fertility.

In China (in contrast to other low-fertility countries) there is an obvious policy change that would likely increase fertility ideals/intentions: a relaxation of policy restrictions on additional births. Most population forecasts for China assume a latent demand for children higher than the current policy level (e.g., Zeng 2007). While most estimates project an increase in birth rates as soon as policy permits these increases, it is uncertain how much intended parity would increase with relaxation of restrictions.

Multiple sources suggest that mean ideals/intentions might remain below replacement even without policy constraints. Merli and Smith (2002) examined a hypothetical question (regarding additional births if government policies changed) asked of women in four Chinese counties. Responses suggested that a policy relaxation would allow some women to have the additional child or children they intended. But few wanted more than a total of two children. Moreover, in some counties they studied, there seemed to be an acceptance of the one-child policy not just as a government goal but as a personal one. Zheng et al. (2008) addressed similar questions in Jiangsu Province in 2006–07 and reached similar conclusions. And Gu and Liu (2009) report that fertility increases associated with relaxing policy restrictions were modest—far less than allowable by the policy change. As Goldstein and colleagues (2003) claim for German-speaking countries in Europe, a generation of constrained low fertility may usher in an acceptance of—or an accommodation to—very low fertility.

In fact, restrictions on births may by now have become anachronistic, inasmuch as social and economic changes are encouraging very small families in China. Rising school fees and increased availability of consumer goods have contributed to the higher costs of raising children; such factors would be expected to decrease intentions for children. A small and nonrepresentative survey of rural women found widespread acceptance of a two-child family (Chu 2001). In another study of fertility in four rural provinces, informal interviews with women suggested that consumer goods were replacing children as a marker of status, and that rural households perceived children's impact on household economic status to be negative (Qian 1997). Fertility ideals/intentions among couples in urban areas are likely to be even lower. Among a sample of people aged 18–30 surveyed in 2003 in Shanghai, the average intended number of children was 1.1 (Xinhuanet 2003, cited in Zheng 2007).

Shifts in fertility timing

Even net of changes in fertility intentions, changes in the other factors outlined in the low-fertility proximate determinants model could produce changes in period birth rates. We begin with one of the better-understood and better-measured determinants of the TFR: F_t, the effect of changes in fertility timing.

Changes in the timing of childbearing influence period total fertility rates net of completed cohort fertility. Bongaarts and Feeney (1998) showed that a rough estimate of this effect is indexed by the change in the mean age at childbearing.[10] To illustrate the influence of timing shifts on the TFR, consider the TFR for first births only. Let us assume that 90 percent of women in each birth cohort will always have at least one child (i.e., fertility "quantum" or magnitude is fixed). Assume further that women's mean age at first birth is steadily increasing. Under these assumptions, the period TFR for first births will dip below the 0.90 children per woman implied by completed fertility rates. In effect, births that would have occurred in the current year (under the existing timing regime) are postponed until subsequent years under the later timing regime, thus depressing the birth rate in the current year. Declines in mean age at childbearing would have the opposite effect on the TFR. Such effects persist until timing changes cease.

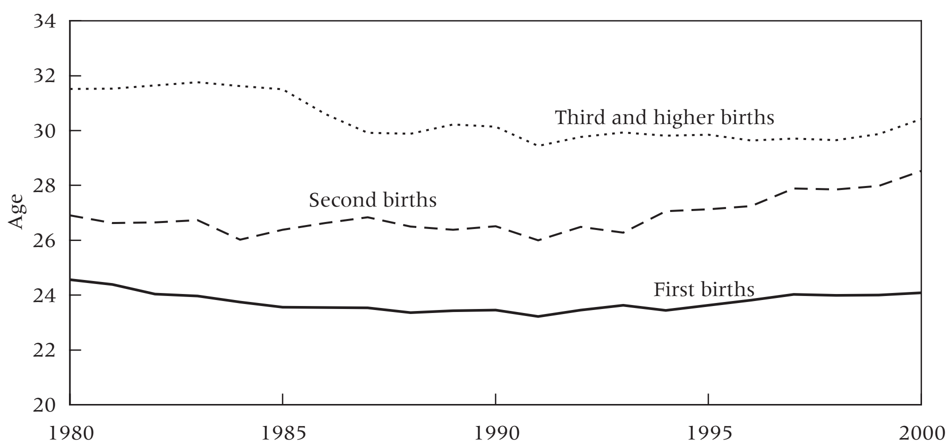
Figure 5 shows trends in the mean age at childbearing for first, second, and third and higher-order births in China. In the last two decades, mean age at childbearing has fluctuated, but postponement is clear in recent years. Figure 5 indicates that recent (post-1990) declines to below-replacement fertility in China have been accompanied by increasing ages at first birth. In contrast, during the 1980s mean age at first birth actually declined. Earlier we attributed these fertility fluctuations in the 1980s to the effects of policy changes—some affecting the age at marriage and at first birth. Timing of second births showed more consistent change, with an increase in mean age at second birth from 26.5 years in 1990 to 28.5 years in 2000.[11]

We use these measures of changes in birth timing to calculate a tempo-adjusted TFR (Bongaarts and Feeney 1998). This adjusted TFR, TFR′, is shown in Figure 6 along with the unadjusted period TFR (as in Figure 1).

These two measures track each other through most of the 1980s, as would be expected given the general stability of fertility timing shown in Figure 5. Beginning in the early 1990s, the tempo-adjusted TFR (TFR′) is clearly higher than the period TFR. The mean difference between the measures is approximately 0.1 children per woman in the early part of the period (1990–95) and exceeds 0.2 children per woman after 1996. The fertility timing factor from the low-fertility proximate determinants model, F_t, is defined as TFR / TFR′; for the post-1995 period, F_t equals .87 (1.50 / 1.72). This recent level of postponement lies midway between levels estimated for the United States and Italy, two other low-fertility countries (see Table 1, row 2).

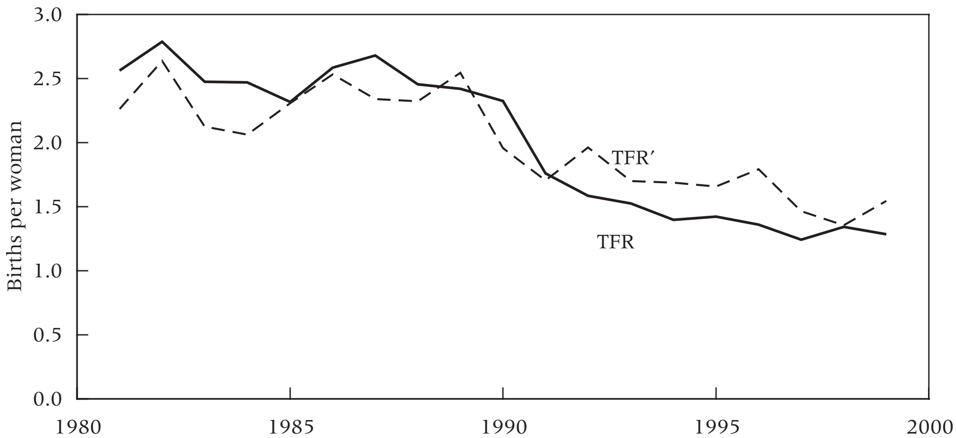
In contrast to other low-fertility countries, China has a relatively young age at childbearing and thus much room for additional fertility postponement in the future. Such postponement will depress period fertility in a predictable way, as described above. Further, such an effect can last for two or more decades. Part of the reason for low birth rates observed during the 1980s and 1990s in many countries was a pervasive shift upward in the ages at childbearing (especially parity-specific age patterns). Bongaarts and Feeney (1998) showed that timing shifts can reduce period fertility rates by 10–20 percent (i.e., by factors of 0.9 to 0.8) for as long as two to three decades. For many countries with very low fertility, up to one third of the fertility deficit relative to replacement levels can be attributed to timing shifts (see Sobotka 2004). Other countries, such as the United States, can attribute all years with below-replacement fertility to postponement of births (see Billari and Kohler 2004; Bongaarts and Feeney 1998). Table 1,

FIGURE 5 Women's mean age at childbearing for first, second, and third and higher-order births, China, 1980–2000



SOURCE: Authors' calculations from 1997 NPRHS and 2001 NFPRHS. See text for details.

FIGURE 6 Estimates of TFR and tempo-adjusted TFR (TFR′), China, 1981–99



SOURCE: Authors' calculations from 1997 NPRHS and 2001 NFPRHS. See text for details.

row 12 shows the adjusted TFR (TFR′) for China, the United States, and Italy (and row 11 shows the observed TFR for those countries). Timing is clearly having a significant depressing effect on period Chinese fertility—these calculations suggest an underlying quantum of 1.72 births per woman. Note that this corresponds closely to the estimates we offered from projecting completed fertility based on cohort data (which do not contain a timing, or tempo, component).

Delayed fertility is not an inevitable response to economic and social change. In Eastern Europe and Russia, for example, mean ages at first birth are in the early 20s (Billari and Kohler 2004). More commonly, however, couples respond to the exigencies of their economic circumstances by postponing family formation. Demands for more schooling, higher professional aspirations, and economic insecurity lead individuals to wait to have children until they have reached some level of stability (Blossfeld 2005; Thornton and Lin 1994). This pattern is pronounced in East Asia, where delayed marriage and nonmarriage have reached levels similar to those of European countries, without the compensating high rates of cohabitation and nonmarital fertility characteristic of Western demographic regimes (Jones 2007). We should expect further delayed family formation in China's future as well.

Other factors affecting fertility

As shown in equation 2, any difference between intended parity and the tempo-adjusted TFR results from two classes of factors. The first set increases TFR′ relative to IP; the second set has the opposite effect.

$$\frac{(TFR / F_t)}{IP} = (F_u \times F_r \times F_s) \times (F_i \times F_c) \tag{2}$$

Above, we estimated the parameters on the left-hand side of the equation (they are reproduced in Table 1, rows 1, 2, and 11). These estimates produce a value of approximately 1.01 on the left side of the equation (see equation 3), which means that the product of the parameters on the right side of the equation must also equal 1.01 (also see Table 1, row 10). That is, the combined impact (of unwanted fertility, fertility to replace children who died, fertility to meet sex preferences for children, subfecundity, and competition between fertility and other desirable activities) is to increase fertility relative to intentions by only about 1 percent.

$$\frac{(TFR / F_t)}{IP} = \frac{(1.50 / .87)}{1.70} = \frac{1.72}{1.70} = 1.01 \tag{3}$$

The figure 1.01 indicates that these factors combined (i.e, right-hand side factors in equation 2) have only trivial *net* effects; however, their separate effects could be substantial but offsetting. For most other low-fertility countries, these parameters have larger effects and their net effect lowers (not raises) fertility relative to intentions. As an illustration of the effects of these factors in other countries, Table 1 shows parameters that Morgan (2003) proposes for the United States and Italy along with values for China (see Morgan and Hagewen 2004 for attempts to estimate these parameters for the US). The estimates for the right-hand side factors in equation 2 are not intended as precise estimates. They are reasonable parameters that reflect the relative magnitude of the different factors; we attempt to justify these parameter estimates as we discuss them.

Factors increasing fertility relative to intentions. We consider three factors that have the potential to increase observed fertility relative to fertility intentions (IP): unwanted fertility resulting from ineffective or nonuse of contraception and/or lack of availability or willingness to abort an unwanted pregnancy (F_u); replacement fertility in response to child mortality (F_r); and additional fertility to meet strong preferences for the sex of children (F_s). Unwanted fertility is uncommon in China, where the intensive state investment in low fertility has made contraception and abortion universally available and its use not only acceptable but frequently mandatory. In the United States, F_u might increase fertility by 10–15 percent relative to IP (a factor of 1.12 is shown in Table 1, row 3; see Morgan and Hagewen 2004), but most low-fertility countries have lower values, such as 1.04 for Italy.[12] We suggest that an appropriate estimate for China is around 1.01.

Replacement as a response to infant or child mortality would have small effects in most contemporary low-fertility countries given the low levels of early mortality. In the United States and Italy, we estimate the effect as less than 1 percent.[13] But in China infant and child mortality is higher and the effect is proportionately greater. Infant mortality and under-age-5 mortality in China circa 2000 were estimated as 28 and 36 deaths per 1000 births, respectively (United Nations 2007). Allowing for replacement of nearly all of these infant and child deaths would increase the TFR by approximately 3 percent, or a factor of 1.03 (see Table 1, row 4).

In Western low-fertility countries, sex preferences concerning children favor a balanced composition (typically one son and one daughter). Any effect on fertility is largely confined to the greater tendency of couples with two same-sex children to have a third birth. This tendency is modest and affects roughly one-half of those with two children. We present illustrative aggregate effects in Table 1, row 5 (for US evidence see Pollard and Morgan 2002). In China, by contrast, preferences for sons are strong.[14] In fact, son preferences are codified in the fertility policy: many rural provinces allow second children (though not higher-parity births) in families with first-born daughters (Gu et al. 2007). Thus, many women have only one child if the first is a boy and an additional child otherwise. Note that sex preferences do not increase fertility relative to intentions if the intentions take them into account (i.e., intend one child if a son; otherwise two children). The widespread availability and acceptability of sex-selective abortions (Chu 2001) imply that son preferences will not produce many high-parity births. (That is, by increasing the likelihood that second and third children will be sons, sex-selective abortion limits the effect of son preferences on fertility.) We assume that sex preferences affect birth rates primarily for couples with two children and no sons; we expect the impact to be substantial but to affect only a small proportion of women. Thus the aggregate parameter estimate is modest in size, 1.04 (Table 1, row 5).[15]

Factors decreasing fertility relative to intentions/policy. Two related factors might reduce fertility relative to intentions: infecundity or subfecundity (F_i) and competition between childbearing and other activities (F_c). These factors are important contributors to low fertility in many other countries, where birth rates in many cases are well below intentions (Bongaarts 2002; Goldstein et al. 2003; Table 1). The framework used here suggests that their current effects are modest in China. In fact, from equation 3 above and as noted earlier, we know that this full set of right-hand-side factors together have weak effects (only 1.01). If our estimates of ($F_u \times F_r \times F_s$) above are correct, then by substitution we can see in equations 5 and 6 that the combined effect of $(F_i \times F_c)$ is only .94 (i.e., to reduce fertility by only about 6 percent).

$$1.01 = (F_u \times F_r \times F_s) \times (F_i \times F_c) \tag{4}$$

$$1.01 = (1.08) \times (F_i \times F_c) \tag{5}$$

$$1.02/1.08 = (F_i \times F_c) = .94 \tag{6}$$

These small effects fit "facts on the ground" in China. Age-related infecundity would likely have a modest effect given relatively young ages at first birth in China. This expectation is consistent with the very high proportions of women having a first child (see Figure 2). Subfecundity and infecundity become more common when mean ages at first birth approach 30 years and when substantial childbearing occurs in the mid and late 30s. Note that the relative magnitude of this factor is set at a much higher value in Italy, where childbearing is much later (F_i=.90 in Table 1, row 7).

In addition to reduced fecundity related to advanced maternal age, untreated sexually transmitted infections (STIs) can lead to sub- and infecundity. Historically, sexual activity outside marriage has been highly controlled in China. However, the opening of Chinese society, and in particular large-scale rural-to-urban migration, have been associated with an increase in commercial sex work and in premarital sex. Recent population-based survey estimates suggest levels of untreated chlamydia infection in urban China as high as or higher than in urban areas in Western developed countries, and levels in rural China similar to those in rural Africa (Parish et al. 2003). Chlamydia is often asymptomatic and therefore goes untreated, which can lead to pelvic inflammatory disease and secondary sterility. In the absence of effective public health campaigns to prevent or treat chlamydia, infection is likely to have increasing effects on secondary sterility in China, especially if age at first birth continues to rise.

The final factor to consider is a residual factor labeled competition (F_c), which accounts for the revisions in fertility intentions women make as their lives unfold. In many Western countries this parameter indicates the process of revising intentions for children downward as the difficulty of combining work and family life becomes more apparent. Alternatively, jobs or the shortage of available men may lead to postponed or forgone marriage, which can reduce women's fertility intentions. Thus F_c in contemporary Western contexts is less than 1.0 and is often credited with a substantial shortfall in fertility relative to intentions (see Quesnel-Vallée and Morgan 2003). The large value for this parameter assigned for Italy (Table 1, row 8; see Morgan 2003) is consistent with a greater incompatibility between family formation and female employment in that country (Rindfuss et al. 2003).

In China around 2000, low levels of childlessness (see Figure 2) indicate that repeated postponement of parenthood is not a major pathway to childlessness. Instead, Chinese women seem very likely to have all the births "allowed" them under current restrictive fertility policy. Perhaps some women even revise intentions upward as they find themselves in situations where they can ignore the family planning policy or can afford the fines it levies on out-of-plan births. Thus, this competition factor, important in many contexts, currently plays a minor role in Chinese fertility levels (i.e., F_c=.98; see Table 1, row 8).

Prospects for future fertility in China

At least partly as a result of the success of past fertility policy in China, population aging is emerging as a major government concern. This concern has led to debate over possible changes in the current antinatal policy. We use our low-fertility proximate determinants model and the experiences of other low-fertility countries to discuss three scenarios for China. Model parameters for these scenarios are shown in the right-most columns of Table 1 with a reference date of circa 2020. Values in bold are those that we predict will differ from values for China shown for 1995–2000.

Scenario 1: No change in population policy

Without a change in fertility policy, many of the model parameters would stay the same as in the "China 1995–2000" column of estimates. Importantly, intended parity (IP) would remain unchanged, reflecting the strong sanctions supporting current population policy. In scenario 1, we forecast changes in F_t, F_i, and F_c. All three changes are linked to continued fertility postponement.

To explain, China is currently unique among East Asian countries, including ethnic Chinese populations in Singapore and Malaysia, in its pattern of early and universal marriage (Jones 2007). As China continues marketization and movement toward a more open society, this distinctiveness is likely to erode. As noted earlier, demands for more schooling, higher professional aspirations, and economic insecurity encourage postponement of childbearing until potential parents reach an acceptable level of stability and economic security (Blossfeld 2005; Thornton and Lin 1994).

This postponement has three separate effects. The first is the "accounting" effect of pushing births into a subsequent year (F_t). These births will occur at later ages and in later years. As noted earlier this effect is substantial in most low-fertility countries including China (where F_t= .87, reducing fertility by a factor of .87 in 2000). We conjecture that this effect will likely intensify slightly (to .85 by 2020) and persist for several decades thereafter.

But some postponed fertility will not be made up. This "forgone" fertility has two components: an involuntary part resulting from declining fecundity (F_i) and a voluntary component related to competition or opportunity costs (F_c). The involuntary component is modest in 2000 (F_i=.96) because childbearing is primarily by women in their 20s. However, another decade or two of postponement implies substantial increases in births to women in their 30s. Subfecundity and infecundity will play a correspondingly greater role (thus the effect of F_i is likely to become greater, reducing fertility by a factor of .94 in 2020).

We also predict that the coming decades will provide more competing nonfamilial opportunities (F_c) to some women. The effect of such competition on future fertility will depend not only on economic changes but also on the social and structural changes that accompany them (see Rindfuss et al. 2003). During the 1950s and 1960s, the Chinese government emphasized the importance of women's labor to economic growth. Perhaps as a result, in 2000 Chinese women perceived relatively little role conflict between employment and childbearing, and their economic contributions to their families were highly valued (Short et al. 2001). It is likely, however, that China's continued economic growth will be associated with increased competition between childbearing and other activities. As China continues to industrialize, increasing numbers of women are likely to be employed in nonagricultural jobs, which are less easily combined with childcare (Entwisle and Chen 2002). Women's continued involvement in the formal labor sector throughout the life course may also reduce the availability of mothers-in-law for childcare.

In sum, increasing postponement of both marriage and fertility, especially in urban areas, will encourage women to revise downward their intentions and lead some women to forego childbearing altogether. For China in 2000, F_c (=.98) had little impact on fertility, but in Scenario 1 we posit that (even without policy changes) F_c will reduce fertility further (by a factor of .96) in 2020.

Together these changes would reduce the TFR slightly, from 1.50 in 2000 to 1.41 in 2020 (with TFR' being 1.66), as shown in Table 1, rows 11 and 12.

Scenario 2: Change to a two-child policy with no restrictions on timing

While this policy change would increase intended parity, it would not raise the TFR to 2.0 since some women would intend fewer than this because of non-policy constraints and pressures. Let us assume that IP increases to 1.8 in 2020 with this policy shift. Net of any other change, TFR would increase by approximately 6 percent ([1.8 IP] / [1.7 IP] = 1.06 = 6 percent). But other changes included in Scenario 1 would still occur and possibly intensify. Specifically, we conjecture that competition would intensify (F_c=.92): more women would now intend two children but fewer would realize these higher intentions because of circumstances later in the lifecycle. Under Scenario 2, the expected TFR in 2020 is thus 1.43 children per woman (and TFR' is 1.68).

Scenario 3: Remove all constraints on family size and on fertility timing

In this scenario, fertility increase might well be substantial in the short run. Marriage age and first-birth timing might decline since couples no longer need to wait for permission to marry and have a child. Also quantum or number might increase because of demand for a second child "pent up" by the current population policy. But this baby boom would likely be quite short, and "soft landing" (adjustment) strategies could spread out the effects of the policy change (Zeng 2007). Beyond a five-year adjustment period (a likely baby boom), we forecast higher but still below-replacement fertility, according to the following reasoning.

We assume a mean intended family size of 2.0, consistent with current evidence (Zeng 2007: 239). Again in the absence of other changes, this increase from Scenario 1 implies an 18 percent increase in fertility. However, other parameters will likely attenuate this impact as in Scenario 2. As noted above, age at marriage and age at childbearing might fall somewhat during the five-year adjustment period, but in the longer term (by 2020) continued fertility postponement is very likely. This postponement, we think, would affect F_t and F_i as in Scenarios 1 and 2.

But F_c, competition, is likely to reduce fertility further (by a factor of .90) in Scenario 3. As in Scenario 2, more young women will increase their intentions in the absence of policy constraints. But more women will also underestimate the effects of other constraints on these higher childbearing intentions, the factor we call competition. The resulting shortfall of actual fertility vis-à-vis intentions may be substantial. Note the range suggested by the contrasts proposed by Morgan (2003) for the United States and Italy (Table 1, row 8) or those implied by differences between intentions/ideals and the actual TFR for European countries (Hagewen and Morgan 2003: Figure 1).

As for factors causing persons to have more children than intended, the only factor whose influence will likely increase is F_s, sex preferences. We forecast an effect double its 2000 estimate (an effect of 1.08) since sex preferences could be more easily pursued by couples with one or more children.

Thus, our overall forecast, even under this dramatic and by no means certain change in fertility policy, is that after a five-year adjustment period, fertility would approach but not surpass replacement levels (we forecast a TFR of 1.62, well below the 2.1 replacement level), and the underlying quantum would approach replacement (TFR′= 1.90). Note that this forecast is based on the well-known features of low fertility captured in our low-fertility proximate determinants model: i) fertility intentions of two children or less; ii) an expected rising age at first and second birth that will have a depressing effect on fertility for as long as two to three decades; iii) weak forces causing couples to "overshoot" intentions; and iv) powerful forces in many and varied contexts that lead many couples to have fewer children than they initially intended.

Conclusion

Retrospective period data (Figure 1), cohort trends by parity from these same data (Figures 2, 3, 4), previous analyses of trends using census data (Cai 2008;

Retherford et al. 2005), China's current set of provincial-level fertility policies (Gu et al. 2007), and women's reports of ideal family size (in the 2001 survey used here; intentions that are undoubtedly strongly affected by the government's population policy mandates) all suggest that contemporary fertility rates in China are well below replacement level. The total fertility rate is in the range of 1.4 to 1.6, and our adjustments for fertility postponement suggest that completed fertility for cohorts now in their childbearing years will be roughly 10–15 percent higher than these estimates imply. Continued socioeconomic development is likely to play an increasingly important role both in reducing fertility intentions in China (because of the growing expense of raising children) and in reducing achieved fertility relative to intentions (because of increases in the mean age at childbearing and increased competition between raising children and other demands). A major unknown is possible changes in current government family planning policy. If policy does change, how will women's intentions change? The low-fertility proximate determinants model we have presented suggests that increases in fertility associated with increased intentions will likely be attenuated by increasing age at childbearing and associated consequences.

Further and in a broader perspective, persistently below-replacement fertility is not alien to this region or this culture. In 2004, the estimated TFR for all of East Asia was 1.6; Japan had a TFR of 1.3, South Korea and Taiwan 1.2 (Population Reference Bureau 2004). Chinese diaspora populations have evidenced rapid fertility declines and low fertility in other contexts (Greenhalgh 1988). While it is premature to say with full assurance that China has joined a group of countries in which fertility stays below replacement level, our data and argument suggest that this is the case.

The aggregate low-fertility proximate determinants framework used here has both strengths and weaknesses. A key strength is its simplicity and transparency (see Keyfitz 1978). Also, key parameters align well with widely accepted substantive arguments (e.g., the importance of fertility intentions and of shifts in fertility timing). Further, some parameters are reasonably well measured in many countries (e.g., the total fertility rate and the effect of timing shifts); other parameters, at least in some contexts, can reasonably be argued to have trivial effects (e.g., the effect of child replacement must be very small in countries with low infant mortality). But the model and the measurement of some parameters should be critically examined and they certainly can be improved.

With respect to China, at least four issues could be addressed by further research. Our model focuses on fertility intentions—current levels and possible changes. A first question: what is the most appropriate operationalization of intended parity (IP)? Is it best conceptualized and measured as the mean of individual intentions—the average report of what people say they will do? Or are reports of the dominant cultural ideal family for "someone like me" a more appropriate measure? Second, Chinese fertility intentions should be measured with policy restrictions in place and with them absent. A new model parameter could be added that captures the deflating effect of current policy on intentions. We have not added this here because data for its measurement were not available. But such data could and should be collected. A first attempt would be to ask respondents what their intended (or ideal) family size is under the current policy regime, and then to ask a parallel hypothetical question that assumes the government has removed all constraints on family size. These questions have been posed at local levels (Merli and Smith 2002; Zheng et al. 2008). The differences in responses would provide one estimate of the effect of current policy on fertility intentions. There are also a series of "experiments" in China where family size limits have been eased. Resultant fertility increases have been modest, suggesting little "pent-up demand" for additional children net of social and economic constraints (Gu and Liu 2009).

A third potentially useful extension would be to estimate the low-fertility proximate determinants model for rural and urban China separately. Women in urban areas and in rural areas are likely to have different fertility intentions, even net of the different family planning regulations. Factors shaping behavior, in particular postponement and competition, are also likely to differ as a result of varying economic and social structures. We do not conduct separate urban and rural analyses here because our retrospective data, coupled with massive and often illicit rural-to-urban migration during the 1990s, create many interpretive difficulties. In many cases the location where women were interviewed differs from the location where their births occurred. But other data may allow for defensible separate estimates for the growing urban population and for the currently still much larger rural component.

Finally, all available data sources point to current fertility levels well below replacement—the reliability of this result is high. Those who argue that underreporting of births leads to serious understatement of fertility need to provide an explanation of and evidence for such underreporting across very different data sources (e.g., for census data and for retrospective surveys). As noted earlier, underreporting is possible: once a child is not reported, he or she could become "non-reportable" for all modes of data collection. If this is true, new data collections will not prove valuable since they would likely suffer from the same bias. Additional detailed and careful fieldwork could provide useful evidence. But to change the broad conclusions here, skeptics would need to show pervasive undercounting across data collection modes at substantial magnitudes. The burden of proof has shifted to the skeptics.

Notes

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1 See Explanatory Note (in English) from Jiang Zhenhua (chief editor), *Data Collection of 1997 National Population and Reproductive Health Survey*. Beijing: China Population Publishing House, 2000.

2 See the preface (in English) by Pan Guiyu (chief editor, and at the time vice minister of SFPC), in *Collection of Data of 2001 National Family Planning and Reproductive Health Survey*. Beijing: China Population Publishing House, 2003.

3 This procedure produces some truncation of childbearing at older ages in years more distant from the survey (see Rindfuss et al. 1982 for a more general discussion of age truncation and retrospective survey data). This truncation is not problematic for most years since no births at ages over 45 were reported and relatively few after age 35. But for ages below 40 that have no sample observations, we imputed the last observed value for this age. These imputations affect only the earliest years in the series, 1980–85.

4 The truncation effects mentioned in endnote 3 might also contribute to our lower estimates as compared with those in Retherford et al. (2005).

5 Our retrospective history reports are .07 births per woman less than estimates of Retherford et al. (2005) for the late 1990s. A likely explanation would be underreporting of births in the retrospective history reports. A 1 percent allowance for underreporting thus brings our estimates into line with own-children estimates, and 2 percent allows for underreporting of children in the own-children estimates as well. Our retrospective history data provide little leverage in estimating the percent of births omitted.

6 Note in Figure 3 that the 1961–65 cohort had earlier second births than the 1956–60 cohort. However, the earlier cohort had a higher cumulative second-birth rate than the 1960s cohort. These patterns reflect period fluctuations in fertility in response to policy changes, such as the change in marriage law in 1980 and the 1984 "open a small hole" adjustment, described above. These period events provoked timing shifts and birth heaping in the early and mid-1980s.

7 The highest-order births occur at older ages. Given our estimation strategy (based on retrospective reports from women aged 15–49), there is differential exclusion of higher-order births. But births are rare at these oldest ages and have become increasingly so. As a result, any adjustment would have trivial effects and would not alter the broad claims being made here.

8 The strategy used by Bongaarts (2001, 2002) is to assume that this generalized period demand for children is best represented by the intended parity of women in the midst of the childbearing years—those near the mean age at childbearing.

9 Using a 2001 survey item on desired family size, Zheng (2004: 77, in Chinese) estimates mean desired children as: total 1.78, urban 1.50, rural 1.88. Our own calculations from these data are: total 1.70, urban 1.43, rural 1.79. The difference in the estimates results from an error in the published estimates. Specifically, the code "9" in the original data is "no answer"; published estimates incorrectly assigned these individuals an ideal family size of 9. In our calculations we treated this code as "missing." There is little variation across age groups in these estimates.

10 Although some improvements have been made to the simple Bongaarts–Feeney adjustment (see Kohler and Philipov 2001; Zeng and Land 2002), it remains a good rule of thumb and a widely accepted template for capturing the effects of timing shifts.

11 Thus the average increase is 0.2 years each year. The Bongaarts–Feeney adjustment implies that the period second-birth TFR is underestimated by 20 percent (compared to

the underlying quantum of fertility) by postponements of this magnitude.

12 We use the value of 1.04 suggested by Morgan (2003). Unwanted fertility is infrequently measured in Europe, but, compared to the US, all evidence points to levels substantially lower in Europe (see Bongaarts 2008), including Italy (Zuanna et al. 2005). But the estimate of 1.04 is offered with substantial uncertainty.

13 Under-age-five mortality in the United States and Italy is estimated as 9 and 7 deaths per 1,000 live births, respectively. Not all births are replaced; for our purposes we assume replacement at the rate of 5 per 1,000, i.e., fertility is increased by 1.005 in Table 1.

14 Scattered evidence suggests that son preference may be decreasing as a consequence of the higher costs of male children (Chu 2001). But elevated sex ratios at birth indicate a continuing strong desire for a son (achieved through sex-selective abortion).

15 The 4 percent (1.04 factor) effect is consistent with the following cumulative cohort birth rates: for first and second births: .95 and .6; for 3+ births 0.0 and .30 depending upon whether one of the first two children is a son. If we assume that 20 percent of women reach parity 2 with no sons, then the 3+ birth rate is .06 (.30 x .20). This produces cumulative birth rates of 1.55 and 1.61 without and with effects of sex preference ($F_s = 1.61/1.55 = 1.04$).

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