Surplus Chinese Men: Three Factors to Guide Chinese Fertility Policies

Catherine Tucker and Jennifer Van Hook

Introduction

China's one-child policy has been the focus of many academic and policy papers. Since 1979, the Chinese government has limited the number of children most Chinese citizens can have. This policy was originally intended to limit the size of China's growing population, but has since had many unintended consequences. One of these consequences has been an imbalanced sex ratio at birth, with many more boys born in each generation than girls. In every year since 1980, more boys than girls have been born in China, a trend that continues to the present day. Researchers estimated that in 2000 there would be 23.5 million excess males in China looking for women to wed (Poston and Glover 2005). How long will the effects of the imbalanced sex ratio persist in China? Could new family planning policies reverse this trend? This paper seeks to address these questions by first identifying the factors that could be addressed by population policy in China and then a population projection to estimate the number of missing males in China.

The projection begins with the 2010 Chinese population. From this base population, we projected forward 50 years into the future to examine how increased fertility, a normalized sex ratio at birth, and a decrease in the age of first birth will affect the future generation’s prospects. These scenarios predict the severity of the problem in the coming years. Finally, this paper will suggest possible policies to ameliorate the imbalance of marriageable age men and women.

The State of China's Population

As of 2010, China's total fertility rate was 1.47. This has resulted in a population with many older people without new cohorts to replace them. Thus, an

ever-decreasing marriage market compounds the problem of marriage for Chinese young people—particularly men, who tend to marry women younger than themselves. Not only is the cohort younger than them slightly smaller in number, it is imbalanced by sex, which limits the number of marriageable women.

Further compounding this problem is the imbalanced sex ratio at birth. Figure 1 illustrates this phenomenon with a time-series for the sex ratio at birth from 1990 to 2010 for China and for the United States. The sex ratio at birth in the United States has been 104.8 for the last twenty years. This is a result of a population that has not used alternate means to alter the sex ratio. In contrast, China's SRB has been imbalanced since before 1990. In 2005, Poston and Glover estimated this trend could continue at least until 2020 if not beyond (Poston and Glover 2005). The chart does show that this has been trending downward since 2004, which is good news for China's future eligible bachelors.

A sex ratio of 105 males per 100 females at birth is considered biologically normal. Males tend to have higher mortality than females during these younger ages, resulting in a sex ratio of approximately 100 by marriageable age. Figure 2 shows the sex ratio in each age category for the United States and China in 2010. In the United States, parity between the sexes is reached by the age of 30, leaving roughly equal numbers of men and women to marry each other. However, in China, a 1:1 ratio is not reached until the age of 70. By then, women are no longer able to have children and many men are left without marriage partners. The imbalanced sex ratio takes 70 years to resolve itself, compared to 30 years in the United States.

Researchers attribute the imbalanced sex ratios at birth to three factors: rapidly falling fertility, a preference for sons, and technology to know the sex of the fetus (Gu and Xu 1994). China began their fertility policy almost 30 years before the infamous one-child policy in 1979 (Tien et al. 1992). The first family planning policies were aimed toward increasing the well being of mothers and their infants. This policy grew out of the Communist party's concerns that China's economic growth would be dwarfed by immense population growth.

The second campaign by the Chinese government was created to target higher fertility. While it was quite successful in lowering fertility in urban areas with access to government health services, fertility in rural areas remained high (Riley 2004). The third family planning campaign introduced the slogan *wan, xi, shao* ("later, longer, fewer") and continued to emphasize similar themes as the second. However, this program had a wider geographic reach and was specifically targeting rural areas. By 1979 though, the Chinese government became convinced that more extreme measures would have to be taken to curtail population growth (Greenhalgh 1990). The now infamous one-child policy was put into place in 1979, with an almost instant drop in fertility. From 1971 to 1979 the TFR fell from almost 6 children per woman to only 2 children per woman (Poston and Glover 2005). This rapid fertility decline, coupled with son preference is what has driven the large sex imbalance at birth.

China has a strong tradition of son preference. The Chinese prefer sons to daughters for several reasons, such as to carry on a family name, to provide support for aging parents, and to assist parents in household production (Gu and Roy 1995;

Kim 1997; Park and Cho 1995; Poston et al. 1997). Before China underwent their rapid fertility decline in the early 1970s, the birth rate was very high and the chance of a family having at least one son was correspondingly high (Pison 2004). When a woman has six children, the probability that none of them will be male is less than two percent. In 1984, the Chinese government eased the one-child policy for rural couples, allowing them to have two children. In a sense, this relaxation of policy institutionalized a cultural value of son preference. Susan Greenhalgh and Jiali Li note that, "son preference moved from being a peasant value (deeply embedded, of course, in social institutions) to becoming a component of informal reproductive policy in the villages, to being incorporated into the formal population policy of the province." (Greenhalgh and Li 1995)

Sex Ratio at Marriage

The sex ratio at birth can be defined as the proportion mal at the time of birth ($t - x$) over the proportion female at the time of birth ($t - x$). The proportion of females is defined as f and the proportion of males is thus $1 - f$.

$$(1)\ SRB = \frac{f^{t-x}}{1 - f^{t-x}}$$

Unlike the sex ratio at birth, men and women of the same age do not marry each other. Instead, men of older ages tend to marry women at younger ages (Bergstrom and Bagnoli 1993). The sex ratio at marriage can be defined as the number of men age x at time t in the marriage market divided by the number of women age y at time t in the marriage market.

(2) $SRM = \frac{P_{x,t}^{m}}{P_{y,t}^{w}}$

Equation 2 reduces to Equation 3. These proportions are a function of the sex ratio at birth, the gender mortality ratio and the population's growth rate.

(3) $SRM = \left(\frac{B^t * e^{-rx}}{B^t * e^{-ry}}\right)\left(\frac{f^{t-x}}{1-f^{t-y}}\right)\frac{l_x^m}{l_y^w}$

Assuming migration is not a factor, the policies affecting China's *guanggun* are primarily the differential mortality of men and women before their age of marriage, the sex ratio at birth and the population's growth rate. Other researchers have reduced the sex ratio at marriage to similar components. (Neelakantan and Tertilt 2008) The next section will explore how changes to these variables will change the number of surplus men in the future.

Three Interventions

While researchers agree that the sex imbalance is a problem, few suggest ways in which China could create policies to address it. Our third equation shows three factors that can influence the sex ratio at marriage. This section suggests three possible interventions; two that are in direction opposition to current population policy, *wan, xi, shao* ("later, longer, fewer"). These interventions would address two parts of our third equation, the population growth rate and the sex ratio at birth. The third part of the equation, the mortality ratio of men and women, would require changes in policy that would be unethical or not feasible. For example, more men would have to die during the crucial years between being born and getting married. We certainly could not suggest a policy that requires more people to die! The other alternative, having fewer women dying in relation to men is also unrealistic. China

has already completed their demographic transition and major mortality differentials because of childbirth have mostly gone away.

One policy to address the sex imbalance would be to urge increased fertility, which corresponds to an increased population growth rate. Women in China report they would prefer to have two children, a boy and a girl (Riley 2004). If this were accommodated by loosening or ending the one-child policy, it could lead to a more balanced sex ratio at birth. In China, son preference is strong. This fact, combined with the one-child policy has led to the imbalanced sex ratios. Thus, if women were allowed to have more children, they are more likely to have female children. Conversely, the 2004 PRB China report showed that SRBs were even more skewed for second children than for first-born children. The fewer children women in China have, the smaller the possible cohorts for marriage. At the present, the TFR in China is one of the lowest in the world, 1.47. This TFR is far below replacement level and means that the population is creating smaller and smaller young cohorts.

The second variable that would affect the sex imbalance is the age of the mother at her first birth. This will impact the SRB in two ways. First, the earlier women begin their childbearing years, the more children they tend to have. Second, this shortens the distance between the generations. The shorter the distance between generations, the more quickly the sex ratio problem will resolve itself. This assumption was tested by reducing the age at first birth by two years.

The final policy would directly target the problem by creating a campaign to normalize the sex ratio at birth. The government could do this in several ways. First, they could create campaigns that would raise the status of women in Chinese

society. Second, they could take more punitive measures for women seeking sex-selective abortions. Finally, they could offer incentives for couples to have female children. For the projections we tested two assumptions of the sex ratio at birth. First, we tested what would happen if the SRB rapidly dropped down to a normal level of 104.8. This scenario is highly unlikely, but helps illustrate which variable has the most effect on the SR for marriageable age Chinese. The second assumption is a decrease in the SRB of 1 percent each year. This mirrors the downward trend seen in Figure 1 and represents a likely scenario given the Chinese government has less intrusive interventions.

Projection Methods and Data

To examine the increasing sex ratio discrepancy of marriageable age Chinese, we used a cohort-component projection method to project the size and demographic characteristics of the Chinese population forward from 2010 to 2060. Rowland describes this methodology as "the most widely used approach to projecting populations" (2003: 439). The cohort-component method beings with a "baseline" population broken down by age and sex categories. A set of fertility, mortality and migration rates are applied to this population to determine the expected number of births, deaths and migration occurring each year for each age and sex grouping. To simplify this projection, we assumed a closed population where migration was zero. The population is then projected forward 5 years at a time by adding the expected number of births, subtracting out the expected deaths, and aging the surviving population. This number functions as the baseline

population for the next five-year projection period. To project the population forward from 2010 to 2060 (50 years), we repeated these steps a total of ten times.

Assumptions

As with all population projections, my projections rest on several assumptions. They are described below.

Baseline Population

We assumed the Chinese population was 1.3 billion in 2010. This assumption is based on estimates produced by the U.S. Census Bureau. The age-sex distribution was also available from the 2010 Census data.

Fertility

We assumed that Chinese mothers had the age-specific fertility rates reported by the National Bureau of Statistics in China in 2008. For purposes of the projection, we altered this beginning assumption in three ways: 1) increasing fertility rates, 2) varying sex ratio at birth, and 3) varying the average age at first birth. Each of these assumptions represents a policy change that China could make the resolve the significant discrepancy in the number of marriageable women and men in the coming years. The government could continue the relaxation of the one child limit to increase fertility, impose strict penalties for sex-selective abortions, or work to raise the status of women in society.

As these age-specific fertility rates were significantly below replacement rate (TFR = 1.47) in all of my analyses we assumed some increase in the overall TFR during the fifty-year projection period. We used two alternate scenarios of increase. The first was a steady 1 percent increase each year until replacement level fertility

(2.1) was reached. The second scenario was a faster increase in fertility (1.2 percent per year) that also leveled off at replacement level fertility. Demographers generally agree that countries with below replacement TFR will eventually return to higher fertility levels (Bongaarts 2004). This has not necessarily been empirically proven, but is still generally agreed upon. Although China's fertility is extremely low after years of the strict one child policy, in recent years, the policy has been relaxed and more couples are having two children. This more hopeful scenario was chosen as the end point for the increased fertility rates. Once the TFR rose to 2.1, they leveled out rather than increasing further.

The second fertility assumption we altered was the sex ratio at birth. The deviations in normal sex ratio at birth have been well documented in other East Asian countries, including China (Arnold and Liu, 1986; Gu and Roy, 1995; Goodkind, 1996; 2002; Kim, 1997; Poston et al.,1997; Eberstadt, 2000). The beginning sex ratio at birth was taken from the U.S. Census Bureau's International Database and was 116.1 in 2010. From here, as with the fertility increase, alter the sex ratio at birth in two ways. The first scenario is the most unrealistic. In this scenario, the sex ratio decreased from 116.1 in 2010 to 105 in 2015. This sharp decline does not necessarily represent feasible policy, but is intended to serve as an illustrative example. Even if the sex imbalance at birth could be solved tomorrow by a government policy, would the population be able to resolve the problem? If this scenario does not resolve the sex imbalance, then the situation is even direr than previously predicted.

The second sex ratio at birth scenario was much less drastic. It assumes a slow decrease of 1 percent per year in the current sex ratio at birth (116.1). The resulting SRB in 2060 is 104.8, which is almost equal to the biological sex ratio at birth. This resulted in an equal percent of men and women for the year 2060 in both of these scenarios.

The third fertility assumption we altered was the average age at first birth. We first calculated the age at first birth from the 2008 age-specific fertility rates, which resulted in an age of 26.2. Seventy percent of births occurred from the ages of 20 to 29. For most of my analyses, we used this age at first birth with the accompanying ASFRs. However, the other age at first birth scenario was a shift to younger childbearing. We shifted the age at first birth to 24.2, two years younger than the original average age of 26.2. To perform this calculation, we determined the distribution of the age specific fertility rates. Sixteen percent of births needed to be shifted to earlier age groups to create an average age at first birth of 24.2. We subtracted the 16 percent of births from the age groups above 26.2 and added 16 percent of births to the age groups below 26.2. These new births were distributed across the age categories according to their original distribution.

Mortality

We assumed that the Chinese population had the same sex- and age- specific mortality rates as China in 1999, the latest year data were available. This makes my projection insensitive to changes in mortality rates. However, in the absence of widespread HIV/AIDS crisis, mortality rates tend not to increase. Thus, my projection would result in slightly more people in the population. The ages we am

examining have relatively low mortality rates and this should not significantly alter my results.

Marriage Patterns

The difference in age at marriage between men and women in China is 2.7 years (UN 2000). Because my data were in 5-year age cohorts, we assumed a 5-year difference in age at first marriage. Thus, women of marriageable ages were from 15-40, while men at marriageable age were 20-45. This means that men at age 20 would be expected to marry women at about age 15. We truncated these bachelor ages at 40 for women and 45 for men. By age 40, 99.8% of Chinese women are married (UN 2000), which means there would be almost no women left at risk of marriage.

Results

Table 1 shows the projected number of excess males in the marriageable age population in 2035. The numbers range from 53 million to 55.6 million, a difference of less than 3 million men. Shifting fertility to younger ages produces only slightly larger discrepancies in the short term. In the short term, changing the SRB will not result in a large difference in the sex ratio at marriageable age. Differences in fertility rates also do not make much of a difference in the number of excess males.

In short, this table shows that regardless of the circumstances, China's population momentum will ensure that this problem persists for another 25 years. This is an increase of 15 years over the estimates given by previous scholars (Riley 2004; Poston and Glover 2005). This table illustrates that even in an extreme scenario where the SRB returned to biologically normal levels within five years, the

number of excess males would persist for a long time into the future. In the short term, China's government has few options for changing policy to solve this problem.

Table 2 shows the results of the 50-year projections. Unlike the middle portion of the projection, more variation exists after 50 years of differing policies. The estimates of excess males range from 12 million to 27 million, with significant variation among scenarios. Not surprisingly, the instant decline of SRB leads to estimates of excess males only one-half of those with SRB that decline more slowly. Even so, 12 million excess males is a substantively large number of people. This is equal to approximately 6.2% of the marriageable age male population that would not have a partner within his age group.

The more feasible policies, increased fertility and younger age at first birth, both have some impact on the number of excess males in the population, but not as significant as the rapid SRB decline. Shifting the age at first birth downward two years results in a slightly lower number of excess males in 2060. The more rapid increase in fertility rates (1.2% vs. 1% per year) also results in fewer excess males. This shows that encouraging these two options could have a small impact on the imbalance of marriageable age youth in China. Although this would result in about 2 million more men with possible partners in 2060, the substantive numbers are still large. This imbalance has been operating in China's population for 30 years and will continue to have effects beyond those 30 years.

But is the problem as dire as it seems? Are there forces besides fertility factors operating that allow this sex imbalance to persist? Table 3 shows the number of excess men in the population, holding mortality constant. This table

illustrates the differences in the sex imbalance in 2060 that are solely caused by the SRB. The results of this table paint a rosier picture for Chinese policy makers. Only 2% of the excess male population is due to a sex imbalance in 2060. Rather, most of the excess is a result of a natural biological sex ratio coupled with low fertility rates for young men. This means that men do not die at a rate that decreases the sex imbalance at marriageable age to parity.

These results show that only 4.7 million excess men would be present in the 2060 population with a standard age at first birth, slowly increasing fertility, and slowly declining SRB. While this is still substantively a significant number of people, in comparison to Table 1 and 2, this table shows other forces are playing a role in the number of excess Chinese men.

Discussion

The projections predict a large excess of Chinese males in China's population until at least the year 2060, and likely beyond. The three policies tested all had some ameliorating effect on the number of excess males, but not even the most restrictive completely solved the imbalance. What other policies could China consider?

One of the key assumptions of this projection is that men will marry women who are five years younger than themselves. Since altering fertility does not appear to solve this situation, perhaps men could marry women who are older than themselves. If they were able to encourage this in conjunction with a rapid decline in the SRB, the number of excess males could almost be resolved by the year 2060. However, changing a cultural practice of marrying younger women is also unlikely

to be an easy prospect. This is a cultural norm not just in China, but also across the entire world (UN 2000).

Another assumption readers might question is that migration was held to zero. Migration is not the solution to China's bachelors for two reasons. First, other countries in East Asia are suffering from a similar excess of males in their population. Importing women from these populations into the Chinese marriage market will only create more problems in their country of origin. Second, the men most likely to remain unmarried are the *guang gun*, who are poor and reside in rural areas. These are the men who are the least likely to be able to import foreign women for marriage (Eberstad, 2000:231; Dean 2000). Furthermore, removing women from other East Asian societies will only complicate their own demographic destinies. The best way forward for China is to innovate their own family planning policies to encourage a solution to the imbalance from within.

Conclusions

Obviously, even with dramatic changes to the population policy, the sex imbalance at marriageable age in China is not an easy problem to solve. The population momentum of 1.3 billion people is like a large ship sailing towards an iceberg; it will not be easy to make quick adjustments. However, my results show that fertility policies are not the only thing contributing to the imbalance of men and women of marriageable age.

As these projections show, the most critical policy change China can make is to encourage a balanced sex ratio at birth. Unfortunately, this is also the most difficult behavior to change. Many Chinese already report they would prefer two

children instead of one, so increasing fertility rates would probably not be difficult (Riley 2004). Changing the age of the first-born also does not appear to have a significant effect on the excess males of marriageable age in the Chinese population, although it does slightly shift it downward.

Rather, China needs to focus on raising the status of women in their society. This includes an emphasis on the importance and value of female infants as well as more equitable conditions for adult women. The final analysis showed that a significant portion of the imbalance at marriageable ages is a result of low mortality among men. It would be unethical to suggest raising mortality among young men, so China should focus on lowering mortality of young women. Again, these decreases in mortality will likely come when women have a higher place in Chinese society.

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Table 1: Estimate of Excess Chinese Males of Marriageable Age in 2035

	1.2 % Fertility		1% Fertility	
	Shifted Age Structure	Standard Age Structure	Shifted Age Structure	Standard Age Structure
Slow SRB Decline	55,360,869	54,669,149	55,670,693	54,990,041
Instant SRB Decline	54,325,111	53,020,022	54,648,219	53,356,472

Table 2: Estimated Number of Excess Males of Marriageable Age in 2060

	1.2 % Fertility		1% Fertility	
	Shifted Age Structure	Standard Age Structure	Shifted Age Structure	Standard Age Structure
Slow SRB	24,120,449	26,026,360	25,369,054	27,230,097
Decline	11.7%	12.3%	12.6%	13.1%
Instant SRB	13,332,724	12,819,564	14,875,488	14,376,546
Decline	6.6%	6.2%	7.5%	7.8%

Table 3: Estimated Number of Excess Males of Marriageable Age in 2060, excluding those due to mortality

	1.2 % Fertility		1% Fertility	
	Shifted Age Structure	Standard Age Structure	Shifted Age Structure	Standard Age Structure
Slow SRB	3,897,861	4,343,193	4,312,706	4,749,164
Decline	1.9%	2.0%	2.1%	2.3%
Instant SRB	988,843	782,582	1,457,190	1,253,207
Decline	0.5%	0.4%	0.7%	0.6%

Figure 1: Sex Ratio at Birth: China and the United States 1990 - 2010

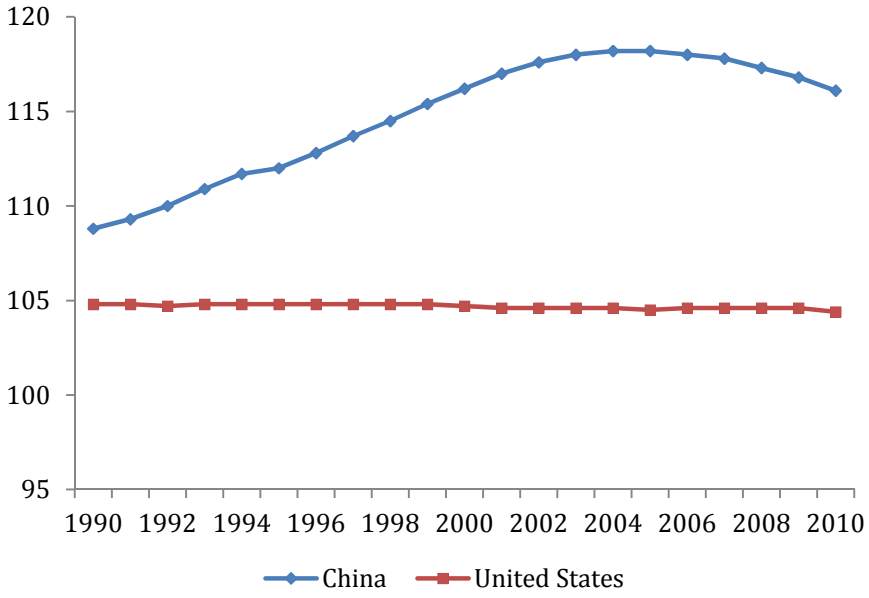

Figure 2: Sex Ratio by age: China and the United States 2010