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Sex Ratios at Birth in China

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Introduction

Fertility transition in China deviates from the classical model in two ways. First, fertility decline in China was extraordinarily rapid with low level of socio-economic development; second, the change has been from a high fertility regime to a low and sex-selective pattern of childbearing. The two processes are directly the result from China's family planning program, which is the most stringent in the world, largely coercive, and has reached all sectors of the population. However, the similar two demographic processes also occurred in South Korea and Taiwan, despite the fact that neither has a heavy-handed family planning program resembling that carried out in Mainland China.

Within one generation (about 20 years), the total fertility rate (TFR) in China dropped from about six children per woman to less than two children per woman. At the same time, the sex ratio at birth (SRB) in China has become abnormally high. The three recent population censuses documented that China's SRB increased from 108 in 1982 to 111 in 1990 and to 117 in 2000. Considerable international attention was devoted to examination and exploration of the trends and determinants of this process (Banister 1987; Hull 1990; Hull and Wen 1992; Johansson and Nygren 1991; Zeng et al. 1993; Gao 1995; Gu and Roy 1995). Scholars within and outside China provide totally different explanations as to the major cause of the abnormally high SRB in China. While foreign scholars point to the predominant importance of the coercive family planning program resulting in excess female mortality from infanticide or abandonment, Chinese researchers emphasize female birth underreporting as the dominant cause of the high SRB, which would imply that the true SRB is still normal. However, the State Family Planning Commission of China in 1999 conducted a nationwide cleaning-up (*qing li*) of the birth underreporting between 1990-1999, which surprisingly found that more male than female births were underreported in virtually all the provinces, and SRB of underreported births was even higher than the SRB of reported births (SFPC 2000). This unfortunately implies that the reported very high SRB may even be an underestimate of the true SRB, thus the situation is worse than it had seemed.

Despite the extensive body of studies on trends and determinants of the abnormal SRB in China, detailed analysis is lacking on the dynamics and patterns of the SRB in China. In addition, new results from the 2000 census show some intriguing characteristics that are not found in the previous censuses. The objectives of the paper are to examine the changing patterns of SRB and to analyse the factors affecting women's sex-selective childbearing in China. Data used in this paper are from China's 1988 Two-Per-Thousand Fertility Survey (sample size of two million women aged 15-57), 2000 National Population Census (one-per-thousand subsample) and 2001 National Family Planning and Reproductive Health Survey (40 thousand women of reproductive age). In the next section, international and historical experience of SRBs is briefly reviewed. Section three examines levels and trends of the SRB in China. SRB patterns and their influencing factors are analysed in section four. Finally section five discusses the implications.

International Perspectives

While purely biological SRB can hardly be determined, observed SRB is a combined result of a wide range of factors. International and historical variations in SRB suggest that they are determined by a range of factors including ethnic differences, foetal mortality rates, fertility rates and social processes (Waldron 1998). Ethnic differences in SRB are typically observed with the populations of negroid origin, where SRBs are generally lower as evidenced by both the cross-country patterns in sub-Saharan Africa and racial difference within countries (Visaria 1967, cited in United Nations 1973; Teitelbaum 1972; Waldron 1998). Visaria (1967, cited in United Nations 1973) argued that the slightly lower SRB for negroid populations may have a genetic basis. The most recent data on SRB both across the world (Figure 1) and within the United States (Figure 2) show consistently lower SRBs for black populations.

Studies also suggest that oriental SRBs tend to be higher than white SRBs which are higher than those of blacks (James 1987a: 723; James 1987b: 875; Clarke 2000: 44). Using data from before the 1980s, researchers find that SRBs in Korea, Japan and to Chinese parents in the U.S. are consistently higher, and it may be suspected that SRB variation across the three main races is partly caused by variation in maternal gonadotropin levels (James 1987b: 876).

Historical declines in fertility and foetal mortality rates probably contributed to the rising SRBs that were documented over certain periods in some developed countries. Decreased foetal mortality (particularly for males) resulting from improved nutrition and maternal health also contributes to higher SRBs. In many developed countries, reductions in perinatal mortality and advances in medical care during pregnancy have particularly favoured male babies, accounting for the increase, though small, in SRBs in the 20th century (Clarke 2000). Declining fertility resulting in fewer higher order births and a larger proportion of low-order births tends to elevate SRBs, as low-order births have higher SRBs. In many populations, SRB tends to decrease with birth order (United Nations 1973). Teitelbaum (1972) reviewed a list of 29 factors associated with SRB, suggesting that birth order seemed to be the most important factor affecting SRB as SRB diminished irregularly from the first birth to the second and so on.

However, the greatly elevated SRB in China (as well as in Taiwan and South Korea) over the last two decades has gone well beyond the forces of these historical changes even if they could have served to raise it. The very high sex ratios at higher-order births in China reported in the recent censuses are in striking contrast to the lower sex ratios observed for similar births in most populations. Since normal SRBs are found typically to lie between 103 and 107 males per 100 females (Chahnazarian 1988; Waldron 1998), an SRB that substantially deviates from this normal range implies deliberate interventions to the roughly equal probability of a male and a female birth.

Figure 1 and Figure 2

Levels and Trends

The trends and dynamics of SRB in China have been documented and examined by a number of studies based on China's large fertility surveys and population censuses. High SRB is not new to the most recent two decades in China. During the 1930s and 1940s, SRB in China was higher than normal as a result of excess female mortality associated with female infanticide. The large reduction in this practice and the improved status of women in the Communist period contributed to the retaining of an SRB by and large within the normal range from the 1950s to the early 1980s (Coale and Banister 1994). It should be noted that the normal SRBs over these periods stood at around the upper limit of the normal range. A 'stopping rule' (selective termination of childbearing following a male birth), and some traditional methods regarding both pre-pregnancy selection changing the sex ratio at conception and prenatal sex selection favouring males, may have contributed to the relatively high SRB within the normal range (Coale and Banister 1994; Jia and Peng 1995). However, from the mid-1980s, SRB in China began to deviate from the normal level increasingly and substantially in the circumstances of declining family size and availability of modern techniques for sex identification. By 2000, China had an SRB of 116.9, the highest figure among the countries of the world. Consequences associated with this severely biased sex ratio are likely to be of global importance when it is taken into account that China's population is 22 per cent of the world total.

Figure 3 plots the trends of China's SRBs over 1955-1989. Data for 1955-1988 come from the 1988 Two-Per-Thousand Fertility Survey; SRBs are the three-year moving averages, in order to reduce large fluctuations due to the very small numbers of cases in the early years. The 1989 SRB is from the 1990 census data. The figure shows that the overall SRB was fairly normal before the early 1980s, and parity-specific SRBs were following a similar pattern. As soon as the one-child policy was initiated in the late 1970s, SRB at parity 3-5+ began to deviate from the normal range, and SRB at parity 2 also started the upward trend in 1984, thus pushing up the total SRB to be abnormally high in 1985. Since then, China's SRBs have risen continously. Throughout the entire period, SRB at first birth remains normal. However, there seemed to be an initial rise in the SRB at first birth occurring in the 1990s, from 105.2 in 1990 (1990 census data) to 106.4 in 1995 (1995 one per cent sample survey data) and 107.1 in 2000 (2000 census data).

Figure 3

In order to examine the relationship between SRB and birth order and to test whether higher-parity SRBs are statistically significantly different from lower-parity SRBs, two linear regressions are run for SRBs separately for 1955-1979 and 1980-1989. Four dummy variables are created for parity-specific SRB X_i (i =2, 3, 4, 5), year represented by X_1 is also entered into the models:

$$Y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 ,$$

where Y is the SRB. The regression results are presented in Table 1. Results of Model 1 show that all SRBs but that at parity 2 are not significantly different from SRB at parity 1. The signs of the regression coefficients demonstrate that SRBs at parity 2 or over are lower than SRB at parity 1, some indication of converging with the pattern previously observed in developed countries. However, the year coefficient is positive, indicating a slightly rising trend in SRBs. Model 2, however, displays a totally different picture of the dynamics of SRB over 1980-1989. All the variables are statistically significant at 0.001, and higher-parity SRBs are increasingly higher than the lower-parity SRB. SRBs at parity 2, 3, 4 and 5 are respectively 6.4, 9.7, 12.2 and 13.5 points higher than SRB at parity 1. The year coefficient indicates that across all parities, SRB gains 1.6 points with an additional year.

Table 1

In the 1990s China had a further dramatic fertility decline, TFR dropping to well below the replacement level. At the same time, the increasing SRB in China has also been intensified. Two fertility surveys in the late 1990s and early 2000s have documented these trends. However, SRBs generated from these two surveys are much higher than the census figures while fertility rates are largely similar. These two surveys, unlike the fertility surveys in the 1980s, have much smaller sample size as their main focus is switched to reproductive health. There can be huge differences in SRB depending on the sample size. The sampling method, multistage cluster sampling, may also introduce bias for SRB, and birth underreporting is also likely to have an effect on SRB from the surveys. Nevertheless, the surveys still provide useful insights into the trends and dynamics of SRB in the 1990s. Figure 4 presents SRBs from the 2001 fertility survey (sample size nearly 40 thousand versus 15 thousand in the 1997 survey), spreading back into the past to 1980. Again, moving averages are calculated for SRBs, but on a 5-year basis, as fluctuations are enormous, as can still be seen in Figure 4.

While levels in SRBs are much higher than what we have previously reported, trends are similar. As births at parity 3 or higher are very few, only three groups of SRBs are calculated: SRB at parity 1, 2 and 3 plus. In the 1990s there was a further dramatic increase in SRB at parity 2 and 3 plus. As shown in Model 3 of Table 1, in the 1990s, SRBs at parity 2 and 3 plus are significantly much higher than SRB at parity 1: on average, 40.3 and 44.5 points, respectively. SRBs were on average pushed up by 1.8 points with every additional year. Comparing the results with those from Model 2, the upward trends which occurred in the 1990s are striking. The three models in Table 1 clearly show the highly differentiated processes and dynamics of SRB changes over the three periods: before 1980, the 1980s and the 1990s. Not coincidentally, these three periods are seen to have intensifying trends in fertility decline largely driven by the implementation of the family planning policy.

Figure 4

Looking at SRBs geographically across China (Table 2), increase in SRB occurred in most provinces between 1990 and 2000: total SRB increased in 26 provinces, and city, town and county SRB increased in 21, 21 and 26 provinces, respectively. Provinces in South-central China gained the largest increments, with Hainan, Guangdong, Hubei, Hunan and Anhui being particularly pronounced with an increment of 15-20 points; while provinces in both East and West China incurred moderate increments. Table 3 shows that across the provinces, SRB on average increased by 5.5 points and the difference between the two censuses is statistically highly significant. This is largely dominated by the change in SRB at the county level, which had an increment of 6.2 points that is statistically highly significant. The gain in city SRB over the two censuses, which is moderate at 3.3 points, is also statistically significant, while the increment of 4.1 points in town SRB is statistically insignificant. It is clear from this, and the fact that city, town and county populations in 2000 are proportionately 23.4 per cent, 13.2 per cent and 63.4 per cent, that China's further precipitously elevated SRB is mainly a result of the dynamics of county and city SRB.

Table 2 and Table 3

One of the notable trends over the last two censuses was the marked increase in SRB in China's largest cities. In 1990, Shanghai and Beijing had an SRB of 104.35 and 106.21 respectively, but these values increased to 110.64 and 110.56 in 2000. Looking at SRB by place of residence within the two municipalities, while Shanghai held a relatively constant SRB (around 110) between city, town and county, Beijing surprisingly had a decreasing pattern of SRB from highly abnormal (112.98) in city and moderately high (109.59) in town to normal (104.89) in county. Across the provinces of China, most cities had normal SRBs in 1990, but only nine provinces in 2000 had normal SRBs in their cities. As China had a migrant population of 138 million in 2000, one may wonder if the abnormally high SRB in urban areas is mainly a result of the high SRB of the migrant population in the urban areas. Table 4 compares the SRB between migrant and non-migrant populations across place of residence. Overall, SRB was higher for non-migrants than for migrants in 2000, and surprisingly this is the case in cities. The statistical test shows that the difference in SRB between the migrant and non-migrant populations is highly insignificant across place of residence. The SRB difference for non-migrants between city, town and county is smaller than for the migrants. From this pattern we can infer that the high SRB in urban areas is not the responsibility of the migrants from the rural areas.

Table 4

This new development of rising SRB in the cities, which is rather unexpected, needs to be carefully examined and analysed, as some of the previous studies argued that the patterns found in Chinese cities implied that the rising SRB in China was not necessarily the outcome of the one-child policy. In Shanghai and Beijing where the one-child policy was most effectively carried out, there was a normal SRB, reflecting a weak cultural setting of son preference (Gu and Roy 1995).

However, the development of a market economy with tremendous risks and uncertainties in a transitional society could reinforce parental reliance on and hence preference for male children. Some studies (Zhu 1998; Zhang Weiguo 2000) show that Chinese peasants choose strategies of early marriage and early childbearing to resist the risks associated with the market-oriented reform. Marriages occur more frequently within the same village (usually a village has a dominant clan) in order to expand and strengthen the power and influence of their patriarchal clan, which makes the bearing of male children more desirable. The same could also apply to the cities, especially when urban growth is increasingly fuelled by rural migrants. In addition, some elements of sex inequality, particularly with regard to employment of college graduates and laying-off workers in the context of rising unemployment and competition, were increasing rather than decreasing in the cities despite an overall pronounced improvement in the social and economic status of females. According to the 2000 survey on women's status by the All-China Women's Federation, 75 per cent of the urban women interviewed state that women are not treated equally with men (calculated by author from the computer record file of the survey data). Interviews with the researchers in the All-China Women's Federation suggest that in the 1990s, while China experienced radical and tremendous changes, notions regarding social gender actually became more conservative, and some critical aspects measuring sex inequalities, particularly the social and economic participation of females versus males, had deteriorated (Interview 2003). In a time of uncertainties and insecurities, sex preference could be strengthened, particularly in the Chinese society where preference for sons has existed and developed for 2000 years.

Another possible reason for the rising SRB in the cities is also associated with the market-oriented reform. Despite the fact that urban residents have fuller and better access to medical facilities and have very low fertility, urban SRB was normal in the 1980s. This phenomenon is in marked contrast to that observed in South Korea and India where urban areas were earlier than rural areas to experience rising SRB with declining fertility. Although less strong son preference and little importance of sons for old-age support could have underlain the normal SRB in urban China, an important aspect would be the more effective government control over urban citizens, which in fact was one of the reasons why urban fertility was declining much more rapidly than rural fertility in China. Until recently urban residents in China have been under extensive and intense control, and monitored by the government through both the household registrations and work units where the urban workers get wages, housing, medical services and also welfare for their children. However, this has been radically changed by the market-oriented economic reform. According to the employment data in China (*China Statistical Yearbook* 2002: 120), urban employment in the non-public sector was only 0.8 per cent in 1980 and 18 per cent in 1990; however, this percentage rapidly increased to 58 per cent in 2000. People working in the non-public sector are largely out of the control of the government; however, they have much higher incomes than those employed in the state or collective-owned units. The government has no longer been able to exert as effective influence and control over them through administrative measures as it did previously. This may lead to more illegal practices of foetal sex identification and sex-selective abortions, at least in the non-public sector in urban China.

Patterns and Covariates

Factors of two broad types at different levels are affecting sex preference in various countries. At the societal level, modernization, cultural settings, socio-economic and political transformation, and population policy and fertility decline are likely to have an effect on sex preference; while at the individual level, socio-economic characteristics of parents directly influence their preference for the sex of children (Kua and Ruffolo 1995). Shryock and Siegel (1971) pointed out that changes and differentials of SRB should be interpreted cautiously, since SRB can be affected by the demographic characteristics of the child and the parents and the socio-economic status of the parents. Among the more than 30 factors summarized by Teitelbaum (1972) and James (1987a), the demographic characteristics of the child and the parents, including family size, age of the parents, age difference of the parents and birth order of the child, and socio-economic status of the parents, including social class and social status, parental occupation and urbanity, usually have a more significant effect on SRB than other environmental, social and behavioural factors. For example, Moore (1958, cited in United Nations 1973) found a negative association between SRB and the age of mother during 1901-54 in England and Wales; Manning et al. (1997) suggest that a large difference in age between the parents tends to predict the sex of the first child; and a number of studies confirm that parents of upper social classes are more likely to have higher SRB than the parents of lower social classes, and SRB correlates to some slight extent with parental occupation (James 1987a). Interestingly, a recent British study of how diet affects the health of new mothers and their babies produced a surprising finding that vegetarian women are more likely to have girls. In the vegetarian women in the study, there were 81.5 boys born for every 100 girls (The Practicing Midwives, August 2000).

While historical data on SRB are not available in China to test the various demographic and sociological hypotheses, in this section, patterns and differentials of SRB in China are examined by the various demographic and socio-economic characteristics of the women drawn from a subsample of the 2000 population census data. The National Bureau of Statistics of China has provided Chinese scholars working on the analysis of the census data with one-per-thousand subsample data of the 2000 census. The empirical analysis in this section is based on these sub-sample census data. The subsample has produced an SRB of 119.38, similar to 119.9 from the total population data (the figures are for the period from 1 November 1999 to 31 October 2000).

Characteristics of the women (percentage distribution) from this subsample are presented in the first column of Table 5. The second column is the percentage distribution of births to the women in the year preceding the census. These two distributions are rather similar across the socio-economic variables (but not the demographic variables including age, birth order and sex composition of previous children). The next two columns are the number of male and female births, according to which SRB is calculated and listed in the last column.

Table 5

A general observation is that very high SRBs are associated with women aged over 30, living in towns, belonging to the Han majority nationality, having primary education and being engaged in service or agricultural work. South-central and East China have much higher SRBs than elsewhere. Children's demographic characteristics have the most dramatic effect on SRB. Most severely biased SRBs occurred to births at parity 2 or over and following daughters only or more daughters as the previous children. The most advanced socio-economic groups, including women living in cities and having the highest education and women cadres and technicians, also have abnormally high SRBs. Fairly normal SRBs occurred only to a limited number of subgroups, including women without any education, living in West China, having first child and continuing childbearing when previous children were all boys.

As the observed bivariate relationships may be distorted by effects from other variables, it is necessary to conduct multivariate analysis to examine to what extent the observed patterns are maintained when other variables are controlled, that is, to look at the effect of one variable net of the effects of other variables. The proper method of multivariate analysis of sex ratio at birth is logistic regression when the underlying dependent variable is binary: coded 1 if there is a male birth and 0 if a female birth. The basic equation of the logistic regression is:

$$\ln\left(\frac{p}{1-p}\right) = b_0 + b_1 X_1 + b_2 X_2 \ldots + b_n X_n \text{ ,}$$

where the dependent variable, sex ratio at birth, is specified in terms of the odds of a male birth, $\frac{p}{1-p}$; the variables X_i (i=1, 2, …, n) on the right-hand side of the equation represent a range of independent variables. All the independent variables are categorical, hence are specified as dummy variables. As elaborated in Retherford and Roy (2003: 21) and Retherford and Choe (1993: 142-147), unlike OLS regression in which substitution of mean values for the independent variables always yields the mean value of the dependent variable, this is generally not the case for logistic regression. In order for the logistic regression to produce the adjusted value of total SRB that is identical to the observed value of total SRB, the constant term in the fitted regression equation needs to be first adjusted by subtracting the sum product of the fitted coefficients and the mean values of the independent variables from the natural log value of the observed total SRB. This yields a new constant term value which is then substituted for the original one (b_0) in the fitted equation. When calculating the adjusted SRBs for all categories of the independent variables from the model, multiple classification analysis (MCA) tables are set up. When calculating the value of $\ln\left(\frac{p}{1-p}\right)$ from the fitted regression for each category of a particular independent variable, dummy values of that variable are set to be combinations of ones and zeros while all other variables are controlled by holding them constant at their mean values. Finally exponentiation of the values of $\ln\left(\frac{p}{1-p}\right)$ yields the adjusted values of SRB. Table 6 presents the results of the adjusted SRBs.

SRBs calculated from the bivariate models are identical to the observed SRBs, while SRBs generated from the multivariate analyses (Models 1 to 3) are the adjusted SRBs with statistical controls. However, the measurement and interpretation of SRBs should be taken with caution, as SRBs are sensitive to sampling methods and sample sizes. The sample involved in this analysis is only 11752 births; the range of SRB variations can be fairly wide simply because of chance or sampling errors. To distinguish statistically significantly (at 5 per cent level) between an SRB of 105 and an SRB of 110, the sample size must be at least 14000 births. Nevertheless, the values of SRB in Table 6 can shed light on the patterns in the general population, and it is useful to consider the patterns and the directions of the effects of the variables.

The bivariate relationships show that across the socio-economic variables, few categories have a significantly different SRB from the SRB of the reference group despite the fact that some observed SRBs are much higher than the reference SRB. This is the case even in Model 1 in a multivariate context. The adjusted SRBs in the second column do not differ much from the observed SRBs in the first column. Across the variables, only the highest SRB at age 30-34 and in South-central China is significantly different from the respective reference group in both the bivariate and multivariate models. Therefore it can be partly explained that abnormally high SRB has spread to a much wider range of population groups, causing a virtual universality in the population of China of highly biased SRBs that differ little from each other.

Table 6

The two demographic variables (at the bottom of the first column), however, have a strong influence on the SRB. SRB at parity 2 or over and SRB at childbearing following female-dominated previous children are significantly much higher. These SRBs become even higher when other socio-economic variables are controlled (Models 2 and 3). It is argued that sex imbalance of births has occurred mainly to women who already have one or more children who are all or mostly daughters (Gu and Roy 1995), and this pattern of SRB is held across virtually the whole range of socio-economic groups of the population (Tu 1993). A study in China's Anhui province also demonstrated that the risk of having a second or third child increased over time for couples who had all daughters (Graham et al. 1998).

Some interesting and important patterns emerged from Models 2 and 3, which have not been previously noted. Regarding age, place of residence and education, the direction of their effects on SRB is almost entirely different from that observed in the bivariate relationships. When other socio-economic and demographic variables are controlled, age is negatively related to SRB, that is, the younger the women, the higher their SRB; city SRB is much higher than county SRB; and education is positively correlated with SRB, that is, the more educated the women, the higher their SRB, and the positive effect of education is statistically significant. As young, urban and highly educated women are more likely to have low fertility, and they are also more likely to have better access to medical facilities and sex-selective techniques, sex-selective abortions are more likely to be responsible for their highly abnormal SRB than for those of women of other characteristics. Similar patterns are also observed in India (Retherford and Roy 2003) and Vietnam (Belanger et al. 2003) where higher socio-economic status is typically associated with higher SRB. Across all three models, patterns of SRB with respect to nationality, occupation and region are fairly consistent and only differ slightly.

Concluding Remarks

All fertility survey and population census data have consistently shown an abnormal upward trend in China's SRB in the mid-1980s that worsened in the 1990s. In 2000, China had the world's highest SRB. Some of the provinces, whose populations are comparable to the large countries in the world, probably have produced SRBs unprecedented in human history. Surrounding the intensified increase in SRB in the 1990s in China is the context of a further drop in fertility to below-replacement level, and rapid and substantial socio-economic transition with market orientation bringing risks, insecurities and uncertainties in work and life, and less effective governmental control over the people, particularly in the urban areas. Sex-selective childbearing seems to be a family-building strategy to adjust to the changing social and economic contexts in which people live.

The 2000 census data showed that SRB was pervasively abnormal across the social strata of women; the adjusted SRBs were over 110 in most socio-economic groups. With statistical controls, younger, urban and higher educated women had higher SRBs. Women in East and South-central China had particularly higher SRBs than elsewhere. SRB at parity two or over and SRB at childbearing following female-dominated previous children were significantly higher than otherwise. With further large and universal fertility decline in China, the abnormally high SRB has spread from East to Central and West China areas, affecting 98 per cent of the total population of China; and there is also an emerging tendency for it to spread from second and higher-order births to first births.

The implication is likely to be that son preference has caused increasing sex-selective abortion, resulting in substantial biases in SRBs. SRB patterns suggest that sex-selective abortions overwhelmingly occur to women with daughters only, who represent a small fraction of all mothers. With declining fertility, the proportion of women with daughters only has increased, but they constitute at most a fourth of all mothers according to the current family planning policy in China. But in reality, women who had daughters only and obtained a sex-selective abortion should be much fewer. To what extent sex-selective abortions have contributed to the very high SRB in China is, however, difficult to capture when nationally representative data on sex-selective abortions and other factors are lacking.

Increasing use of sex-selective abortion is more marked and visible evidence of son preference when smaller family size is desired either for normative or policy reasons, or some combination of the two (Poston 2001). However, with the rapid decline of fertility, people are increasingly aware that high fertility is no longer a convenient, economic and effective approach addressing their family size goals (Tu 1993; Peng and Huang 1999). Sex-selective strategies, particularly sex-determined induced abortion, are preferable to parents, and the wider application of ultrasound-B technology in China since the early 1980s has reduced both the monetary and psychological costs of sex selection (Peng and Huang 1999). Unfortunately, repeated abortions for achieving the desired number and sex of children are associated with considerable health consequences for women under extraordinary pressure to have one or more male children.

However, sex-selection based abortions in China are not the inevitable result of the family planning policy. Whether or not there is a family planning policy, and whether or not people are voluntarily controlling fertility, sex-selective abortions are inevitable as long as people want fewer children and want those to be male. Recent increases in the sex ratio at birth in China's big cities suggest wider application of sex-selective abortions. Other Asian societies, particularly Taiwan and South Korea, that share the same Confucian patriarchal tradition, strongly and pervasively prefer sons. In these areas sex ratios at birth have also been distorted substantially through sex-selective techniques, but neither has a family planning program in the nature similar to that carried out in Mainland China (Gu and Roy 1995; Poston 2001).

The rising and abnormally high SRB in China, as a result of sex-selective abortions, has important implications for the demographic transition theory. Critics of the demographic transition theory hold that the theory is not effective in predicting the demographic trends after World War II. Three major demographic trends have gone beyond the demographic transition theory: the postwar baby boom in the Western countries, significant mortality decline in the developing world, and the rapid fertility decline in the Asian countries (Chen and Huang 1999). Now it seems that the demographic transition theory is unable to capture a fourth demographic trend—rising SRB—that is occurring in some of the Asian societies (i.e., Mainland China, Taiwan, South Korea and India) experiencing rapid fertility decline. The rapid decline in mortality and fertility in the developing countries is attributable to the substantial social and economic changes and technological progress largely transmitted from the developed countries. The same reproductive technology development has now resulted in another demographic transition, a transition from low, normal SRB to high, abnormal SRB in these countries.

Recent debate (see a discussion by Li 2001) in China over the post-transitional fertility points to the importance of looking at China's demographic transition both quantitatively and qualitatively. Conventional measures assessing the demographic transition are crude birth and death rates or total fertility rate and life expectancy. The present values of these measures in China are clear indications of the end of the transition from high to low fertility and mortality. Quantitatively, China has completed demographic transition, largely as a result of the implementation of a stringent family planning policy although socio-economic development has also played an important role. However, even without changes in fertility preference, the fertility level could be brought down by exogenous forces. The strong son preference was conflicting severely with the one-child policy, resulting in the policy change that had to incorporate and accommodate this sex preference. This is a qualitative aspect of the demographic transition in China, and only the endogenous forces, that is, socio-economic development, can finally make a difference. In fact, at least in East China where socio-economic development is much more advanced than in the rest of China, the intensity of son preference has declined. Peasants want at least one son and at most two sons. Not very many want two sons and virtually no one wants more than two sons. As one son is the cultural boundary, only further modernization would lessen this preference. The central government's decision in 2000 on strengthening population and family planning work and stabilizing the low fertility has called for the effort to normalize SRB by 2010. However, until Chinese society is fully modernized such an effort would make little difference. The demographic transition needs to be regarded as an integral component of the overall transition of the society from a traditional to a modern one. Efforts promoting the demographic transition need to be addressed within a framework of comprehensive development and modernization.

When demographic transition is discussed, replacement-level fertility (2.1 births per woman) is typically taken as the measure of the completion of a demographic transition. However, replacement fertility is dynamic rather than static if it is looked at in a historical perspective. Replacement fertility is a product of three things: mortality, fertility and sex ratio at birth. Historically when mortality is very high, replacement fertility should also be very high: for example, according to the Coale-Demeny 'West' model life table, when life expectancy at birth stands at only 30 years, replacement fertility would be as high as 4.4. When the demographic transition reaches its end, replacement fertility is calculated to be 2.1 under the assumption of life expectancy at birth being 70-75 years and SRB being 105 or 106. However, when SRB is distorted to be abnormally high, a replacement fertility taking into account of this, other things being equal, would also become abnormally high. Calculation based on China's 2000 life table shows that the 2000 replacement fertility in China would be 2.31 when taking into account the 2000 SRB of 117, while a normal SRB of 106 would produce a replacement fertility at 2.14. Thus China's demographic transition realities have important implications for demographic transition theory, which typically assumes replacement fertility to be the endpoint of the transition.

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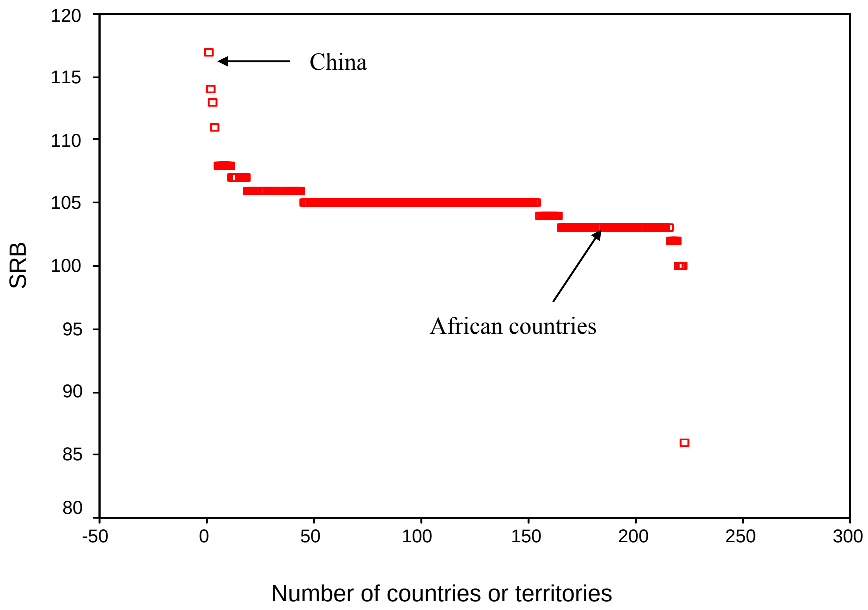
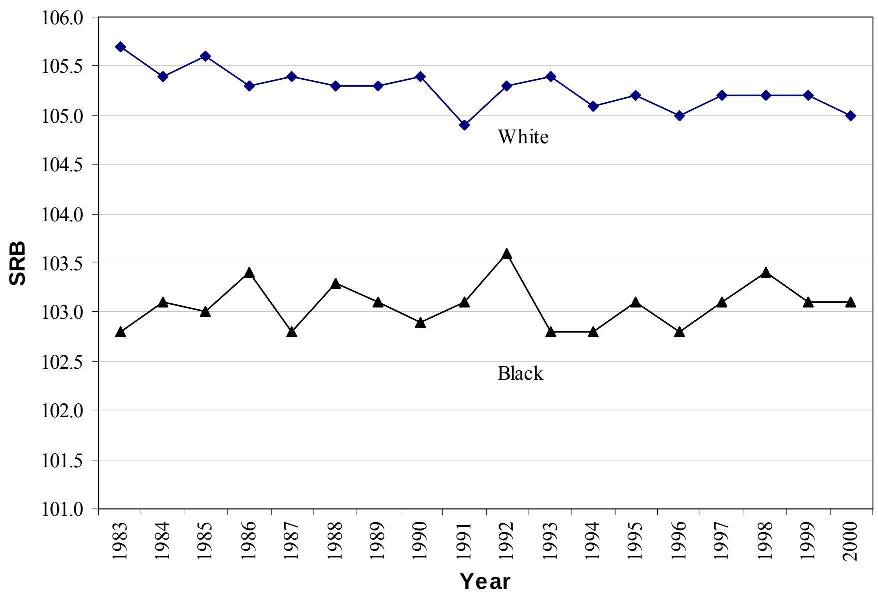
Figure 6.1 Sex ratio at birth for countries or territories of the world, 2000



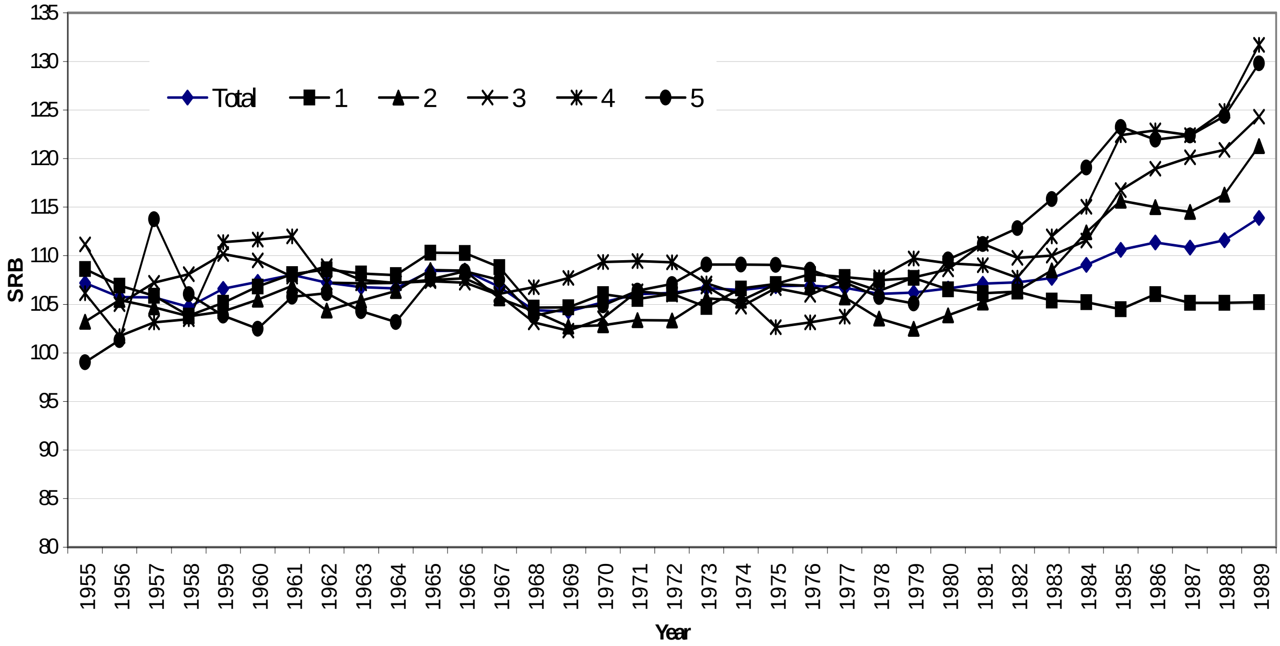
Source: SRB for China is the 2000 census figure, SRBs for all other countries or territories are from *World Fact Book 2000*. http://education.yahoo.com/reference/factbook/invert/sex_ratio.html. Date accessed: 4 May 2003.

Figure 6.2 Sex ratio at birth for the White and Black populations of the United States, 1983-2000



Source: US National Center for Health Statistics, *National Vital Statistics Reports*, vol. 50, no. 5, Feb. 12, 2002. http://www.infoplease.com/ipa/A0005083.html. Date accessed: 4 May 2003.

Figure 6.3 Sex ratio at birth by parity, China, 1955-1989



Source: Data for 1955-1988 come from the 1988 fertility survey; the 1989 figure is the 1990 census data.

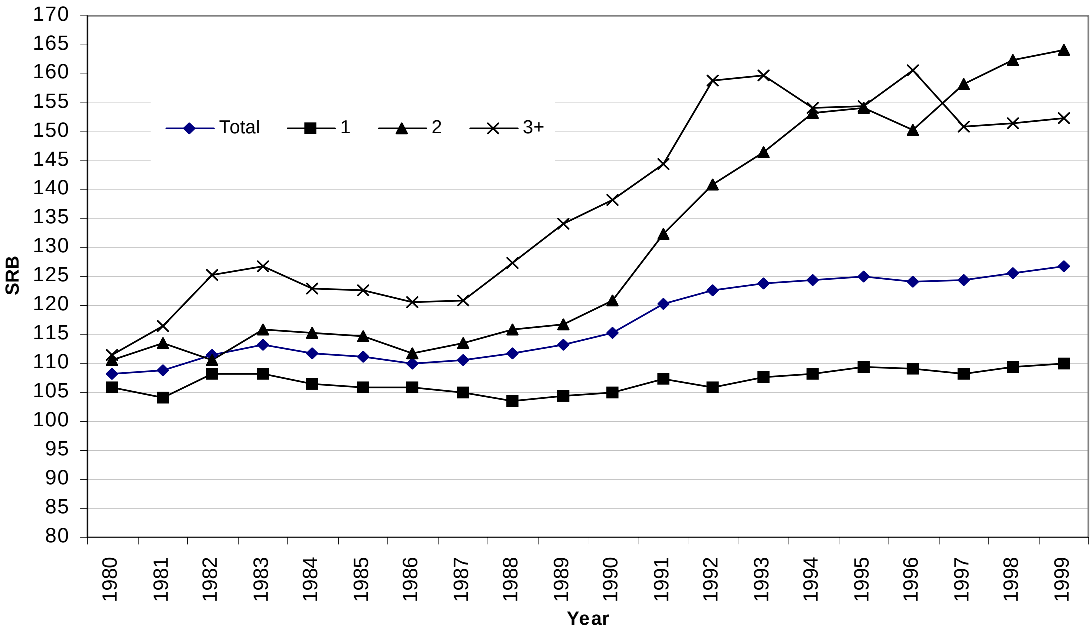
Table 6.1 Regression coefficients testing the difference in parity-specific SRBs, China, 1955-1979 (Model 1), 1980-1989 (Model 2) and 1990-1999 (Model 3)

Variables	Model 1	Model 2	Model 3
Year	0.004	1.621***	1.837***
SRB at parity 2	-2.015**	6.354***	40.307***
SRB at parity 3	-0.226	9.666***	44.475***
SRB at parity 4	-0.036	12.180***	
SRB at parity 5+	-1.041	13.475***	
Model significance	*	***	***
R-square	10.3	82.4	90.9

*P<0.05, **P<0.01, ***P<0.001. Calculated using SPSS 11.0.

Source: 1988 and 2001 fertility survey computer record data file.

Figure 6.4 Sex ratio at birth by parity, China, 1980-1999



Source: Computer record data file of the 2001 fertility survey.

Table 6.2 Sex ratio at birth by place of residence, 31 provinces of China, 1990 and 2000

Provinces	Total			Cities			Towns			Counties		
	1990	2000	Δ	1990	2000	Δ	1990	2000	Δ	1990	2000	Δ
Beijing	106.2	110.6	4.4	105.7	113.0	7.3	102.2	109.6	7.4	107.5	104.9	-2.6
Tianjin	110.7	112.5	1.9	106.6	106.4	-0.2	103.3	112.0	8.6	116.1	120.2	4.1
Hebei	112.3	113.4	1.1	106.1	109.6	3.5	113.4	112.9	-0.5	113.0	114.3	1.3
Shanxi	109.7	112.5	2.9	110.2	108.9	-1.3	111.6	114.6	3.0	109.5	113.1	3.7
Inner Mongulia	107.4	108.5	1.1	104.0	106.3	2.3	104.0	106.2	2.2	109.0	110.1	1.1
Liaoning	110.1	112.8	2.7	106.1	110.3	4.2	109.0	114.9	5.9	113.1	114.2	1.2
Jilin	108.1	111.2	3.1	105.1	110.8	5.7	106.9	111.1	4.2	109.4	111.6	2.1
Heilongjiang	107.4	109.7	2.3	105.9	109.9	4.0	106.8	109.4	2.6	108.5	109.7	1.2
Shanghai	104.4	110.6	6.3	104.6	110.5	5.9	101.5	111.6	10.1	104.3	110.3	6.0
Jiangsu	114.5	116.5	2.0	112.8	111.8	-0.9	108.4	116.9	8.5	115.2	118.5	3.3
Zhejiang	117.8	113.9	-4.0	106.0	110.9	4.9	120.7	115.7	-5.0	119.8	114.6	-5.2
Anhui	110.5	127.9	17.4	109.5	113.3	3.9	109.5	125.0	15.5	110.7	130.9	20.2
Fujian	110.5	117.9	7.4	111.1	113.8	2.7	121.0	117.1	-3.9	109.6	119.5	9.9
Jiangxi	110.6	114.7	4.2	111.2	113.0	1.9	113.6	107.4	-6.2	110.3	116.4	6.1
Shandong	116.0	112.2	-3.8	114.2	109.0	-5.2	117.8	111.2	-6.5	116.2	113.6	-2.6
Henan	116.6	118.5	1.8	114.3	112.9	-1.5	116.1	122.4	6.3	116.9	119.0	2.1
Hubei	109.5	128.2	18.7	108.7	120.9	12.3	113.8	125.6	11.8	109.4	132.4	23.0
Hunan	110.5	126.2	15.7	106.4	115.9	9.5	110.7	122.2	11.5	110.9	129.0	18.0
Guangdong	111.8	130.3	18.5	114.0	124.5	10.4	121.0	133.4	12.4	109.8	132.8	23.1
Guangxi	117.7	125.6	7.8	113.5	117.2	3.6	111.0	127.4	16.4	118.4	126.5	8.1
Hainan	115.6	135.6	20.0	107.8	140.5	32.7	135.4	139.5	4.1	114.7	132.8	18.1
Chongqing	–	115.1	–	–	107.3	–	–	110.3	–	–	118.1	–
Sichuan	111.5	116.0	4.5	108.9	109.7	0.9	104.7	110.3	5.6	112.2	118.2	6.0
Guizhou	101.8	107.0	5.3	98.8	105.6	6.8	107.8	112.0	4.3	101.9	106.6	4.7
Yunnan	106.8	108.7	1.9	105.5	104.3	-1.2	105.4	104.7	-0.7	107.0	109.7	2.7
Tibet	103.1	102.7	-0.3	106.9	102.9	-4.0	105.2	103.8	-1.3	102.6	102.6	0.0
Shaanxi	111.1	122.1	11.0	115.1	115.3	0.2	114.3	114.0	-0.3	110.5	125.6	15.1
Gansu	110.3	114.8	4.5	107.4	111.4	4.0	115.1	120.9	5.8	110.6	114.8	4.2
Qinghai	104.6	110.4	5.7	112.4	105.7	-6.7	92.8	106.2	13.3	104.4	111.9	7.5
Ningxia	110.0	108.8	-1.3	108.8	105.1	-3.8	113.0	104.8	-8.2	110.0	110.1	0.1
Xinjiang	103.7	106.1	2.4	106.0	107.1	1.1	104.1	105.1	1.0	103.3	106.0	2.8
Total	111.1	116.9	5.7	109.0	112.8	3.9	112.2	116.5	4.3	111.8	118.1	6.3

Note: Δ is the absolute increment of sex ratio at birth from 1990 to 2000.

Sources: The 1990 data come from Office of Population Census under the State Council, 1991, *10 per cent Tabulations of China 1990 Population Census Data*, China Statistics Press. The 2000 data are from Population Division of National Bureau of Statistics of China, 05/09/2002, S/5454.

Table 6.3 Difference in average SRB by place of residence across the provinces

Place of residence	Average SRB 1990	Average SRB 2000	Difference
City	108.45	111.73	3.29*
Town	110.67	114.78	4.11
County	110.48	116.70	6.22***
Total	110.02	115.52	5.49***

*P<0.05, **P<0.01, ***P<0.001; the figures represent the unweighted provincial average, not the national values.

Source: Table 6.2.

Table 6.4 Sex ratio at birth by migration status

Migration status	Male births	Female births	Sex ratio at birth
City			
Non-migrants	728	621	117.23
Migrants	536	466	115.02
Town			
Non-migrants	689	562	122.60
Migrants	196	152	128.95
County			
Non-migrants	3869	3214	120.38
Migrants	377	342	110.23
Total			
Non-migrants	5286	4397	120.22
Migrants	1109	960	115.52

Source: Computer record data file of one per-thousand subsample of the 2000 Census.

Table 6.5 Socio-demographic and economic differentials in sex ratio at birth, China, 2000

Characteristics	Women	Births	Male births	Female births	Sex ratio at birth
Age					
15-24	24.15	37.39	2308	2086	110.64
25-29	14.59	42.50	2711	2284	118.70
30-34	16.30	16.25	1115	795	140.25
35-50	44.96	3.85	261	192	135.94
Place of residence					
City	26.13	20.01	1264	1087	116.28
Town	14.10	13.61	885	714	123.95
County	59.77	66.39	4246	3556	119.40
Nationality					
Han	91.57	87.11	5599	4638	120.72
Minority	8.43	12.89	796	719	110.71
Education					
Illiterate	7.46	5.22	309	305	101.31
Primary	32.70	29.37	1917	1535	124.89
Junior middle	40.72	48.33	3088	2592	119.14
Senior middle	14.72	12.14	768	659	116.54
College+	4.40	4.93	313	266	117.67
Occupation					
Cadres and technicians	5.99	6.57	406	366	110.93
Service personnel	9.99	6.95	453	364	124.45
Agricultural workers	50.94	56.31	3644	2973	122.57
Industrial workers	9.87	6.19	383	345	111.01
Unknown	23.21	23.98	1509	1309	115.28
Region					
North	12.43	11.67	713	659	108.19
Northeast	9.14	6.35	395	351	112.54
East	29.67	26.72	1739	1401	124.13
Southcentral	27.36	27.94	1891	1392	135.85
Southwest	14.24	18.84	1144	1070	106.92
Northwest	7.16	8.48	513	484	105.99
Birth order					
1	3.16	68.73	4149	3928	105.63
2	1.20	26.08	1865	1197	155.81
3+	0.24	5.19	381	232	164.22
Sex composition					
No children	8.32	68.75	4149	3928	105.63
Sons only	33.10	9.33	564	532	106.02
Daughters only	23.55	19.17	1502	750	200.27
Sons>daughters	5.98	0.31	13	24	54.17
Sons=daughters	21.04	1.91	124	100	124.00
Sons<daughters	8.01	0.54	43	20	215.00
Total	100.00	100.00	6395	5357	119.38

Note: Distribution of women by birth order is summed to be 4.60 per cent, the remaining majority 95.40 per cent did not have childbearing in the year preceding the census.
Source: Computer record data file of one per-thousand sub-sample of the 2000 Census.

Table 6.6 Adjusted sex ratio at birth by socio-demographic and economic variables based on logistic regressions, China, 2000

Independent variables	Bivariate	Multivariate		
		Model 1	Model 2	Model 3
Age				
15-24 (ref)	110.64	111.18	125.02	125.76
25-29	118.70***	118.69	118.12	118.06
30-34	140.25*	138.04***	112.88	110.44*
35-50	135.94	137.50*	108.57	113.07
Place of residence				
City (ref)	116.28	118.51	122.94	123.26
Town	123.95	127.06	128.12	127.64
County	119.40	118.12	116.62	116.62
Nationality				
Han	120.72*	119.91	120.37	120.01
Minority (ref)	110.71	115.84	112.85	115.16
Education				
Illiterate (ref)	101.31	105.52	95.92	98.79
Primary	124.89*	123.55	117.59*	117.84*
Junior middle	119.14	117.90	119.10*	118.61*
Senior middle	116.54	120.67	129.57**	129.34*
College+	117.67	121.95	137.71**	137.83*
Occupation				
Cadres and technicians (ref)	110.93	107.89	109.41	109.97
Service personnel	124.45	120.20	121.34	121.38
Agricultural workers	122.57	124.16	122.80	122.46
Industrial workers	111.01	106.78	110.33	110.77
Unknown	115.28	114.96	116.20	116.68
Region				
North	108.19	108.48	107.42	106.75
Northeast	112.54	115.13	118.38	116.16
East	124.13*	123.81	127.67**	124.50*
Southcentral	135.85***	134.01**	133.38**	135.11***
Southwest	106.92	107.58	104.17	106.76
Northwest (ref)	105.99	107.40	105.61	106.12
Birth order				
1 (ref)	105.63		102.11	
2	155.81***		164.21***	
3+	164.22***		190.23***	
Sex composition				
No children (ref)	105.63			101.99
Sons only	106.02			112.50
Daughters only	200.27***			211.37***
Sons>daughters	54.17*			61.67
Sons=daughters	124.00			136.20*
Sons<daughters	215.00**			243.90**

*P<0.05, **P<0.01, ***P<0.001; ref=reference group.
Source: Computer record data file of one-per-thousand subsample of the 2000 Census.