The Geography of Deteriorating Child Sex Ratio in China and India[1]

Christophe Z GUILMOTO, Isabelle ATTANÉ

1. Introduction

China and India share a large number of common traits in their recent social and economic transformations. While the most single visible facet of this convergence tends to be the economic surge both countries have experienced over the last two decades, demographic commonalities are also numerous. In particular, the deterioration of child sex ratio has run parallel in China and India over three decades with no sign of improvement during the last ten years.[2] In both countries, fertility decline has been accompanied during the same period by a strong desire by couples to intervene on the sex composition of their offspring. While excess female mortality among girls (including cases of sex-selective infanticide) played a role in the skewed sex distribution observed in the past, sex-selective abortions are probably the main cause today for the rapid degradation of child sex ratio, which is above 110 boys per 100 girls in India and above 117 in China (Das Gupta *et al.*, 2003; Chu Junhong, 2003).

When comparing the trajectory of both demographic billionaires, it is important to stress that the increase in child sex ratio started earlier in China and distorted sex ratio levels are today both more widespread and pronounced. To some extent, this may be related to the course of fertility transition which took off earlier in China, starting from the 1960s whereas sustained decline in birth rates in India only dates back to the 1970s, and which was much more drastic in China, especially in rural areas (Figure 1). Interestingly enough, there is an almost similar

---

[1] A first version of this paper was presented at the IUSSP International Population Conference held in Tours in July 2005.

[2] See other chapters by Arokiasamy and Li *et al.* in this volume for more detail on national trends.

gap in the timing of the reforms that launched the economic liberalization in both countries and inaugurated a period of uninterrupted growth.

This paper will therefore start with a comparative analysis of fertility change and policies in both countries. But we will also examine the spatial patterns of sex ratio differentials, which are indeed quite different in China and India. To do that, we will provide sex ratio maps for China and India and estimate the magnitude of local changes in child sex ratio values between the last two censuses. The paper concludes with a discussion related to the nature of the mechanisms at work in the degradation observed in both countries, followed by a brief explanation of some of the possible factors behind the spatial patterning of sex ratio differentials and trends observed both in China and India.

2. China and India: Similarities and differences

The similarities between China's and India's experiences offer an interesting material to examine the dynamics of sex ratio deterioration that has run unabated in both countries during the last phase of their fertility transition.

2.1. Divergent birth control policies and recent fertility trends

Both China and India experienced sustained fertility decline over the last thirty years. The mean number of children per woman decreased from 5 in 1971 to 2 in 2000 in India.[3] The decline was even more significant in China, with this value dropping from 5.4 to 1.8 in the same period of time (Figure 1).

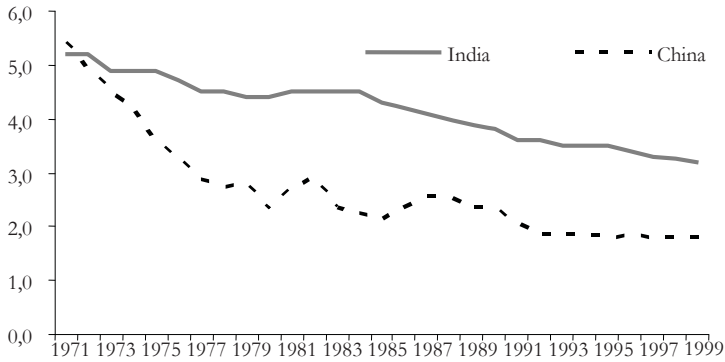
In both China and India, but to different extents, large-scale fertility decline started with government encouragements, although birth control policies were implemented with various degrees of efficiency from the 1950s (Attané, 2002; Greenhalgh and Winckler, 2005; Guilmoto and Kulkarni, 2004). This section sums up the history of family planning policies in both countries.

India has the distinction of introducing the first family planning programme sponsored by a government. The programme was initiated in 1951 as a part of the First Five-Year Plan of India, but without any significant contraceptive acceptance during this period. By 1961, when the Third Five-Year Plan (1961-66) was introduced, it was realised that

[3] The latest estimate from the National Family and Health Survey puts fertility at 2.7 children per woman for 2005-06.

fertility had not declined and that population growth needed to be controlled through fertility regulation. A number of developments took place in the mid-1960s, in technology, emphasis, strategy, and organization. The intra-uterine device became widely available and the 'target approach', which specified targets for contraceptive acceptance, was introduced. A broad consensus emerged among the elite during the 1960s about the need for fertility regulation. A related development was the liberalization of induced abortions in India in 1972 and the first mass sterilization camps organized in Kerala from 1970. Acceptance of contraception increased substantially throughout the late 1960s and the early 1970s, but the trend was irregular.

Figure 1 Trends in total fertility rates in China and India, 1971-1999



Sources: For India, Sample Registration System: SRS; For China: (1971-1990) Chen, Coale, 1993; (1991-1999) Attané, 2001.

The most severe intensification in the programme took place during 1975-76 as the state of national emergency was declared in India in 1975 and the administrative machinery acquired a range of unprecedented powers. Various government programmes including family planning were given priority and specific targets and there was greater pressure on health workers to achieve the quotas in terms of family planning acceptors. The imposition of press censorship prevented any organized opposition to government programmes. Finally, in 1976, the first explicit National Population Policy for India argued that it would not be wise to merely wait for economic development to achieve demographic changes as stipulated during the Bucharest Conference. A number of measures were proposed to achieve the goal of reducing the birth rate by 10 points by 1984 among which the demand for compulsory sterilization was explicitly recognized. There was a phenomenal

rise in the acceptance of sterilization. But these pressure tactics became so strong that the distinction between persuasion and coercion got blurred and there were numerous complaints and protests against compulsion and post-sterilization deaths. Compulsion in family planning became a major issue in the elections to the Indian parliament held in early 1977, which were finally lost by the ruling Congress Party.

One of the severest critics of the emergency period family planning programme became the Minister for Health and Family Planning in 1977 and his new population policy categorically ruled out any compulsion in family planning. While the new policy also made it clear that the new government was committed to promoting a small family norm and supporting family planning, the programme stood totally discredited. Acceptor targets were termed as "guidelines" and family planning workers were not given quotas. Moreover, after the experience of the 1977 elections, family planning became a risky programme for political leadership to support. In spite of the overall setback, acceptance of reversible contraception increased steadily. Oral pills were introduced in the programme in the mid-1970s and the acceptance gradually rose. Resentment towards the programme weakened over time, acceptor targets were specified, and acceptance increased steadily in the 1980s. Thus, the 1980s was a period of balanced approach with greater integration of health and family planning, relatively free of controversies and it witnessed a slow rise in acceptance of contraception. By the early 1990s, the family planning programme in India had reached a stage where awareness about contraception was nearly universal among the adult population.

In 1993, the Indian government constituted a committee, known as the Swaminathan Committee, to formulate a population policy. This committee submitted its report in 1994, which was nearly contemporaneous with the 1994 International Conference on Population and Development (ICPD). The issues addressed were fairly similar and, like the ICPD, the Swaminathan Committee report also reflected the new approach to population. A small family norm was advocated, yet the choice was left to the couple. Population policy was to be driven by the perceived needs of people rather than imposed from the top. Finally, in February 2000, the Government of India announced its latest population policy. It contained several elements of the policies recommended by the Swaminathan Committee and the ICPD.

During the same period, China opted for a coercive birth limitation policy in order to promote its economic development. At the start of the 1970s, the demographic transition in China was still modest. Mortality was declining. Life expectancy at birth had gained twenty

years since the 1949 Revolution, from 41 years in 1950-1955 to 60 years in 1965-1970 (Huang and Liu, 1995). But the birth rate kept rising to all-time highs. With fewer deaths and more births, population growth peaked at more than 2% per year, hitting 2.8% in 1968. Twenty million people were being added each year. After having been left aside for some years, birth control became a national priority again. In 1971, the State Council Directive 51 marked the official launch of the third birth-control campaign which, unlike its two forerunners, would be pursued relentlessly in the following decades. Three directives were issued in 1973, summarized by the slogan "late, spaced, few" ("*wan*, *xi*, *shao*"), i.e., marry late, space births, and have fewer children (Attané, 2002). Annual birth quotas were imposed. However, the infinite diversity of settlement patterns, cultures, contexts, constraints, modes of production, and other factors did not escape the promoters of this third campaign. The population was officially classified into three groups: urban, rural, and ethnic minorities. From the outset, urbanites were subjected to the strictest rules: no marriage before 25 for women, before 28 for men, and no more than two children. By comparison, peasants were privileged: they were allowed three children and their minimum legal age at marriage was set at 23 for women, 25 for men. No prescribed conduct was defined for ethnic minorities. In any event, as small groups mostly confined to low-density peripheral areas and accounting for a limited share in the total population, they did not have a major role to play in fulfilling the birth-control objectives.

In less than ten years, fertility was halved–from an average 5.7 children per woman in 1970 to 2.8 in 1979. This was the steepest decline ever recorded in the world in such a short time span. In urban areas, women already had fewer children than needed for cohort replacement: the number had fallen to 1.4, compared with the 2.1 required to ensure that two children replace their two parents, allowing for mortality. At Mao Zedong's death in 1976, the birth-control program had already achieved remarkable results and dispelled the threat of a population boom that the country could not support. But this was still not enough. Signs pointed to a resurgence of the birth rate that threatened to jeopardize these fragile gains. Birth control had to be tightened even further. The "*reform and opening policy*" (*gaige kaifang zhengce*), inaugurated in 1978 by Deng Xiaoping, was therefore assigned a second objective: to curb population growth in order to finally ensure economic take-off. A new policy officially announced in January 1979 imposed the draconian rule of the single child. Moreover, the rule applied to almost all of China: 95% of urban dwellers and 90% of rural dwellers were supposed to comply. To promote the measure, the authorities established a reward system. Couples had to pledge to have

only one child by signing the "*one-child certificate*" (*du sheng zinü zheng*). In exchange, they would receive various compensations, which varied considerably from one locality to another: monthly bonuses of a few yuan, free medical care and education for the child, easier access to housing, allocation of an additional small plot for peasant families, retirement bonus for employees of State-owned enterprises, and so on. Reversely, couples who resisted the government injunctions faced a variety of penalties, such as the obligation to reimburse the bonuses received, income deductions, fines, partial confiscation of the family plot, and dismissal for recidivist employees of State-owned enterprises (Attané, 2002).

Since 1984, given the presence of hot spots of resistance, the one-child rule is thus no longer systematically enforced in rural areas. There, families–in particular among certain ethnic minorities–are generally allowed to have a second and even a third child. But the eligibility criteria for a second child, however, can vary from one province to another and sometimes even from one district or village to another.

Today, family planning still relies on the same weapons: persuasion, coercion, and fines. But reforms have led families to gradually emancipate themselves from collective institutions. Birth control is slipping out of the hands of the regime's cadres, and coercive measures are failing. To remain effective, regulations need to be adjusted. By promoting local initiatives, decentralization has made it possible to institute new types of penalties more directly targeted at family interests. Nevertheless, the "Population and Birth Control Act" passed in September 2002 reasserts the goal of strict limits on the number of children. Recent developments suggest, however, changes in the means used to reach the objective. The program's emphasis has been shifting toward voluntarism for two reasons: first, because it is increasingly difficult for the authorities to interfere in couples' private lives; second, because the threat of unsustainable population growth has now been eliminated. The new focus is on health: reproductive health, education, and information being the main priorities (Scharping, 2003).

These divergent trajectories toward birth control–closely related to the nature of the political regime ruling each country–have probably had a strong impact on fertility decline, India displaying in 2001 fertility levels almost twice higher than those observed in China.

2.2. Deteriorating sex ratio at young ages

Fertility decline in both countries has been accompanied by a more rapid decline in female births than of male births, inducing deteriorating sex ratio at birth. In both countries, a large segment of couples chose not only to select the number of children to be born, but also to manipulate their "quality" by reducing actively the share of girls in their offspring.

Abnormally high male proportions are not a new phenomenon in China and India, the overall sex ratio reaching 108 males per 100 females in both countries in 1950 as against values below 100 observed elsewhere (United Nations, 2006). India's demography had long been characterized by high sex ratio value as was observed from the first census in 1871-72. This was especially true of areas in the Punjab region of colonial India where the practice of female infanticide had been identified early on. In China during the 1930s and 1940s, gender distribution, especially at young ages, was already imbalanced as a result of excess female infant and child mortality associated with sex-selective infanticide. A weakening of this practice and the improved status of women in the Communist era contributed to retaining sex ratio at birth within the normal range (Chen Wei, 2003). But from 1979, the one-child policy turned de facto into a one-son policy. In India, long-time distorted sex ratios were traditionally due to excess female mortality at reproductive ages and to infanticide, while sex-selective abortions are as in China increasingly responsible for the deteriorating sex ratio at birth. Today, discrimination against girls is rising year by year. Thus, the sex ratio at birth–lying usually between 103 to 106 boys for 100 girls (Chahnazarian, 1988)–rose from 105.0 to 112.0 in India between 1982 and 1999, and from 107.2 to 116.9[4] in China between 1982 and 2000. This substantial deviation from the normal range implies deliberate interventions on the roughly equal probability of a male or a female birth. Although the influence of each method used to reach this outcome may vary, sex-selective abortions and excessive mortality among female children are the main determinants of observed distortions, while female infanticide and pre-conception sex selection are probably far less common.

In China and India as well, the gender differential infant mortality gap widened to the detriment of girls as child survival gradually improved. But mortality during the first year of life is usually higher among males. Excess male infant mortality is a universal phenomenon. Hill and Upchurch (1995) calculated the observed normal female

[4] This figure refers to births between November 1, 1999 and October 31, 2000.

advantage by establishing the ratio of female-to-male infant mortality at 0.78 for a male probability of dying in the first 5 years of life below 0.05. In China, this advantage had already been lost by 1973-75, with a ratio of 0.875, and is increasingly waning: 0.948 in 1981, 1.156 in 1990, and 1.465 in 2000 (Attané, 2004). In India, data are often less reliable and therefore trends appear less discernible (see however Arokiasamy in this volume). Sex differentials in child or infant mortality are however more pronounced in north-western areas and almost absent in the rest of the country. Excess female infant mortality remains visible at the national level, with female-to-male ratio above the expected levels: 0.9 in 1992-93 and 1.0 in 1998-99.

The reasons of this excess female infant mortality are well-established and somewhat related to fertility decline, which caused the expression of son preference to escalate. In China, for instance, as the family planning policy imposes a prior authorization for each birth, and inflicts administrative, financial, and occupational penalties on non-compliant couples, girls become unwanted simply because they deny their parents the possibility of a son. In both China and India, poor rural families, in particular, allocate more food to a son than to a daughter and are more inclined to provide them with costly medical care. However, the emergence during the last 20 years of sex-selective abortion has gradually displaced the role of "traditional methods" of sex selection such as neglect or infanticide.

2.3. Traditional son preference[5]

Discrimination against females is a product of Chinese culture. Traditionally confined to the domestic sphere, a good wife had "to serve her husband and his parents, to take care of the house and to have male heirs". Supported by her family until her marriage, the daughter was then entirely devoted to her husband's family. So, a female birth rarely causes delight, especially for the poorest. Because of superstition, millions of parents still name their daughters "Laidi" (literally "A boy is following"), "Pandi" ("Hoping for a son") or "Zhaodi" ("Bring us a son"). After marriage, a girl owes nothing to her parents. She does not have to take care of them when they become old; that is the duty of a son–and of a daughter-in-law. In the countryside, people still have to "have a son for old age", as they will never have any retirement pension. For hundreds of millions of peasants, a son is the only guarantee for old age, and against illness or disability.

[5] Descriptions of local contexts for son preference in Chinese and Indian settings are provided in particular in the chapters written in this book by Sekher *et al.* and by Bossen.

In spite of the recent economic development, the Chinese woman remains "inferior to man" and some wives are still ill-treated or repudiated when they are "incapable" of giving birth to a son. The patriarchal clan system–the foundation of traditional social organization–requires early marriage and numerous children, especially males, to maintain clan and family power. Today, family solidarities remain strong and many features of patriarchal culture still dominate daily life such as patrilocal marriage, patrilineal filiation or ancestor worship. Moreover, perpetuating the family name is one of the fundamental male duties in Confucian culture and the absence of a male heir is the worst dereliction of filial devotional rules, especially in rural areas. To have a son is ultimately an indispensable condition for perpetuating ancestor worship.

Rural decollectivization provided another reason to discriminate against girls. The family recovered its function as an economic unit, of which it had been deprived during the collectivist period. Thus, the larger the family, the greater are its opportunities to become richer, as land allotment is made on the basis of family size. In the countryside, people often consider that "the early marriage of a son has three advantages: daughter-in-law, descendants and land". In cities, a child costs more than he yields. In the countryside, he has an economic value as he works in the fields, takes out the livestock, etc. Rural exodus and growing disinterest for land labour have not altered the necessity to have a son; if he leaves the farm, he will get a more lucrative job in the city.

Many of the features observed for China hold true in rural India where girls are perceived of lesser values than boys. Several cultural traits of the kinship systems tend to reinforce women's inferiority and subordination to men. One recent development that probably reflects very accurately the declining status of women is the institution of dowry. The dowry paid by the bride's family to the groom's tends to be perceived as an extra burden imposed on parents with girls. While dowry was historically a custom restricted to some communities (especially high castes or specific communities in North India), the institution has rapidly spread across regions and across social categories. It is now fairly common among lower-status groups that use to practise in the past bride-price instead; dowry is also practised today in most regions of South India, where it was previously rare except among some Brahmin castes.

At the same time, the dowry inflation has been flourishing unchecked for reasons of social and economic pressure that are still now not well understood. It is clear that a dangerous combination of eco-

nomic development, prosperity and social diffusion of new family norms has fuelled the propagation and inflation of dowry. But whatever the cause of these inflationary trends, the result has been to put additional pressure on families with girls and serves as a strictly economic justification for sex selection. Traditional preference for sons, inherited from the landed classes of rural society, has now turned into an economic rationale pursued by upwardly mobile middle-classes seeking to maximize their social benefits (reputation, prestige, alliance, etc.) in the marriage market.

Dowry has long been officially banned in India, but this prohibition has had almost no impact on actual marriage transactions. Its rise over the last four decades points not only to the very limited influence of the Law on private social arrangements, but also its rather weak implementation, which indicates the prevalence of double standards in such matters. As the Indian government has recently strengthened its regulations banning sex-detection tests, it will be crucial to monitor the implementation of this law to assess the exact nature of the impact of the government's involvement.

3. Trends in spatial heterogeneity

3.1. Sex ratio statistics

We will now examine the geographical distribution of child sex ratio in both countries. For this purpose, we make use of disaggregated data from the last two censuses in China (1990 and 2000) and India (1991 and 2001). No other data set provides an exhaustive sex and age count for both national populations. We will use the sex ratio computed for the child population, a measurement that combines the effect of various sex discrimination practices such as sex-selective abortion, female infanticide and excess girl infant and child mortality among girls. This offers a rather synthetic measure of gender discrimination especially as it is not known either to be significantly affected by sex differentials in migration rates.

While China follows standard age classification (below 1 year, 1-4 years, 5-9 years etc.), India's data are not always available in the usual quinquennial age format. Figures given by the Census of India often relate to the populations aged "less than 7 years". While different from the standard age classification, this age format is not without advantages: Owing to the relatively high level of age heaping in India, which is also associated to sex of the children such as for exact age 5, the 0-6 year age group tends to offer a more robust measurement of sex ratio

than the usual 0-4 group. The difference in age group between the two countries has little impact in our comparison since adding ages 5 and 6–when child mortality is very low–is unlikely to alter the overall sex ratio among children.

Data from these censuses are available at various administrative levels in both countries.[6] In China, the larger units are the 33 province-level units (provinces, municipalities and other regions), further divided into 333 prefectures while the finer units correspond to counties (*xian*). There were 2391 counties in China at the time of the 2000 census out of which 2368 spatial units could be retained in this study. In India, sex ratio data can be examined on the basis of the 35 States and Union Territories, but use of the 593 district units (as of 2001) provides a finer mapping of sex ratio variations. Data are also available in a GIS format that will allow us to conduct a detailed spatial analysis of inter-censal changes in sex ratio in both countries.

3.2. Mapping sex ratio in China and India

Child sex ratio is characterized everywhere by pronounced geographic disparities. While many areas are unaffected by sex ratio imbalances, there are on the contrary so-called hot spots of girl deficit, i.e. compact areas where sex ratio is uniformly much higher than the national average. As a result, it is often less than half of the country that is responsible for the bulk of sex ratio distortion, while the rest of the country display normal values.

We prepared several maps based on the 1990 and 2000 censuses for China and on the 1991 and 2001 censuses for India. We used here the sex ratio computed for the age group 0-6 for India while retaining the 0-4 age group for China. Data pertain to the Chinese counties (*xian*) and the Indian districts, administrative units of roughly comparable demographic size (Guilmoto and Oliveau, 2007). However, instead of keeping the original administrative boundaries, we computed the surface values for each map and contoured them in class intervals. Surface estimation was conducted using the standard geostatistical kriging method (Fotheringham *et al.*, 2000). As a result of this procedure, original administrative boundaries are no longer visible. Large contiguous areas of homogeneous sex ratio levels appear now more clearly on the final cartography, even when they cut across higher-level units such as Chinese provinces or Indian states. We also used the same class break values for both countries, though average levels of

[6] Data are missing for Taiwan (China) and for a few districts in Jammu-Kashmir and Gujarat (India).

child sex ratio are different with India recording significantly lower values than China. This may not be appropriate for individual maps, but it facilitates the comparison between the two countries. Scales for each country are also comparable.

It is beyond the scope of this paper to produce a detailed geographic analysis of sex ratio variations within both countries (Guilmoto 2005). Maps shown here (Figures 2 and 3) illustrate clearly several common features. First, sex ratio imbalances are not equally distributed in each country. Child sex ratio is almost normal in all provinces of West China (not shown on the maps). Many regions in India appear similarly unaffected by the national rise in child sex ratio. Moreover, there is a distinct clustering of regions with high values. Areas characterized by higher sex ratio tend to be close to each other and the geographic distribution is far from being random. This translates into high levels of spatial autocorrelation for the child sex ratio variable. A further point is that maps tend to exhibit the same patterns across time and there is no radical change in the geography of sex ratio after ten years in spite of the rapid increase observed during this period.

A closer examination helps, however, to identify some significant variations between both Asian countries. For example, female discrimination is more acute in urban areas in India than in the countryside, a feature not found in China where some of the largest cities appear rather less affected than rural areas. An equally puzzling aspect of this comparative cartography relates to the geographical patterning of child ratio in both countries. Regarding China, we may first note that child sex ratio is close to normal values in most regions where minority nationalities predominate. This is the case for most provinces in western China not displayed here. But this does not signify that the rest of the country is homogeneous with higher sex ratio values observed everywhere. Central and East China is characterized in fact by a great number of regional hot spots with high child sex ratio surrounded by other counties with lower values. There are indeed many zones characterized by extreme sex ratio values above 120 flanked by adjoining areas where sex ratio is below 110. Consider for instance the large pocket encompassing the bordering counties of Anhui, Hubei and Henan where sex ratio is often above 150. Our map shows it to be surrounded by counties within the same provinces (especially Anhui and Hubei) where sex ratio levels are almost normal.

On the contrary, India is characterized by a single, global orientation of its sex ratio patterns, with higher than usual values recorded in the north-western quadrant of the country from Gujarat to Punjab along India's western border. In the rest of the country, child sex ratio

hardly exceeds normal values and hot spots of abnormal sex ratio tend to be few and small. A systematic geostatistical analysis of child sex ratio data confirms this observation. Spatial autocorrelation appears in India much stronger than in China and extends over a larger radius (Guilmoto, 2005). This means that irrespective of the fact that sex ratio levels are on the whole considerably higher in China than in India, the spread of sex discrimination appears more compact in India and less scattered away across different subregions.

Figure 2 Child sex ratio (0-4 years), East China, computed from county data, 2000 census

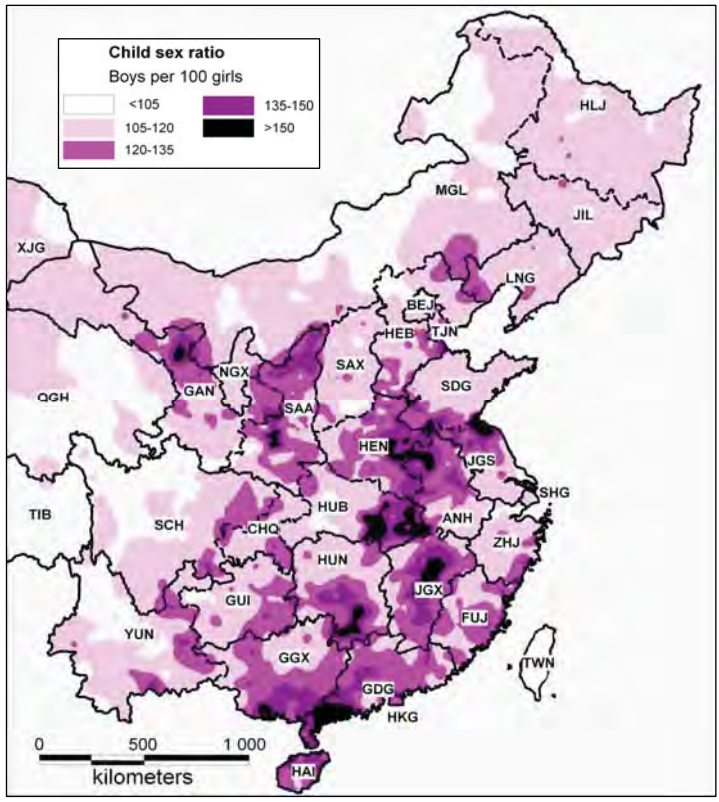


Figure 3 Child sex ratio (0-6 years), India, computed from district data, 2001 census.

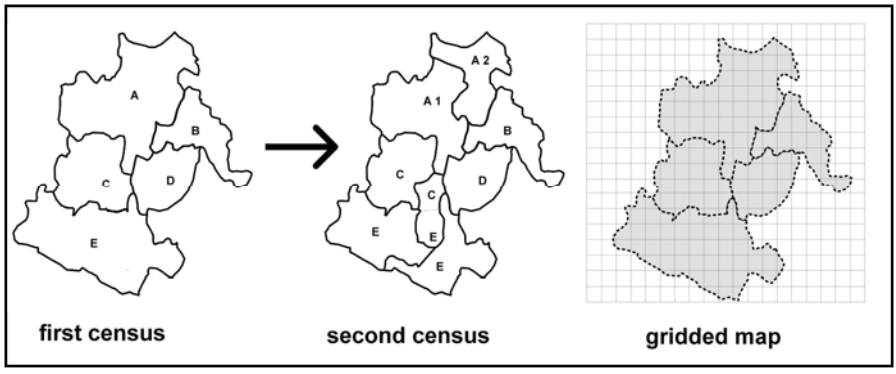
This geographic pattern obtained in China may appear surprising in view of the seemingly stronger political and cultural homogeneity of this country. Demographic behaviour and gender bias would be expected to follow heterogeneous ethnic or social lines, but it appears that variations in sex ratio are most prominent within the *Han*-dominated areas that constitute most of eastern and central China. On the contrary, one would presume that India's sex ratio would be extremely segmented in view of the internal cultural diversity of the country. But high sex ratio areas in India illustrated by the maps cut across several states from Punjab to Maharashtra with different linguistic, religious and cultural characteristics. The spatial patchwork observed on the Chinese map would actually be less surprising in India, a cultural area characterized by its heterogeneous social composition, than in China where the homogenizing impact of state policies on the social fabric should be more pronounced.

3.3. Spatial trends of child sex ratio in China and India

The second part of the study concentrates on the spatial examination of the trends in sex ratio by comparing the last two censuses in China and India. However, a strictly longitudinal approach is made difficult, if not impossible, by the numerous changes in the administrative structure of each country between successive censuses. Figure 4 provides an example of administrative redistricting: unit A is bifurcated into units A1 and A2 while units C and E give rise to a new unit C-E. India had for instance 593 districts in 2001 as against only 466 in 1991. Intercensal comparison is therefore not readily possible as sex ratio estimates for the first census are not available for all the new districts that appeared only in the second census.

The use of GIS-based interpolation techniques makes it however possible to estimate child sex ratio values for administrative units that do not exist in a given census. The method consists in using surface maps of child sex ratio for two periods rather than try to use administrative units that may change between subsequent censuses. As stressed above, surface maps do not follow the original administrative structure of each census. They are based on interpolated values for individual spatial cells of given size (Figure 4). Once continuous maps are available for two different periods, the trend map can be computed by superimposing both maps and computing the difference in cell values.

Figure 4 Illustrations of change in administrative boundaries and gridded map



The resulting contoured maps of intercensal change in child sex ratio are shown below (Figures 5 and 6) and refer to the 1990s for both China and India. These maps indicate precisely where the increase in child sex ratio took place during the ten years under study. And as can be seen, this rise in sex discrimination is not at all uniform across both countries. Nor has this change been spatially random. In each case, the

increase in the proportion of boys has been concentrated in a few regions. By and large, these regions coincide with the areas where the sex ratio was already abnormally high ten years earlier.

3.4. Structural or local changes?

To understand the implications of this analysis, it may be useful to re-examine the process of spatial change. From a theoretical viewpoint, change may also be divided into two components: a national trend affecting all regions simultaneously and regional trends that are found only in given areas. The national trend would be associated to structural factors likely to have had a similar impact on every region. To some extent, this component of change can be considered "a-spatial" as it does not possess any distinctive spatial property. This would imply in particular that the increase in sex ratio observed in China or India would have been the result of broader change in the social or economic structure of society. On the contrary, regional (or local) factors are delimited and pertain more specifically to local social or economic characteristics and dynamics.

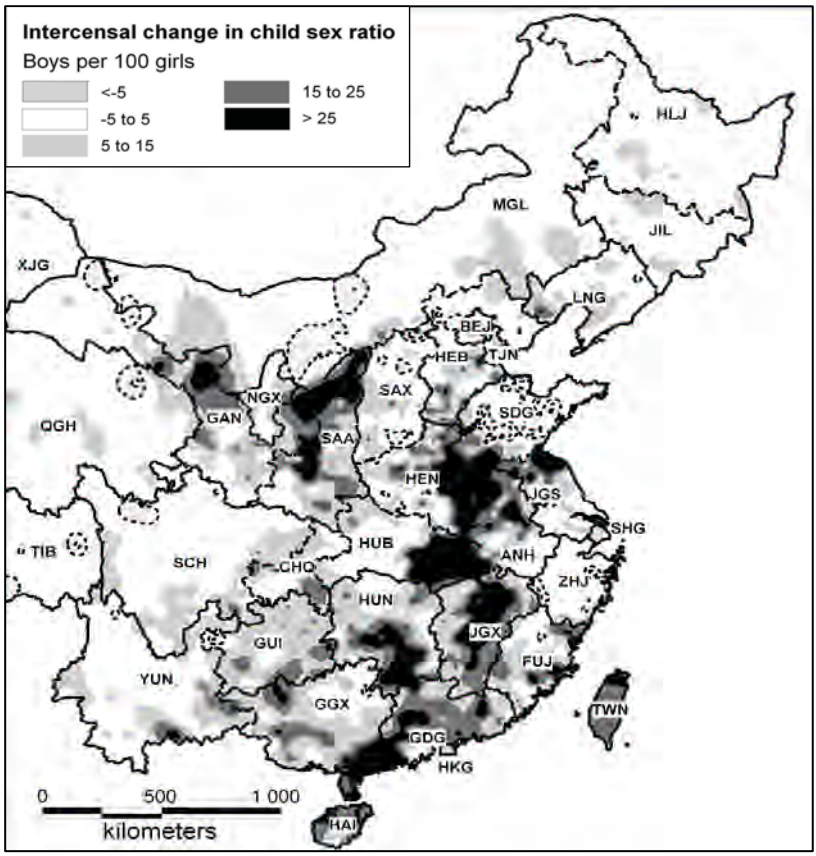
The trend maps shown here indicate that the structural component *per se* appears to have played but a rather limited role in the change that has occurred during the ten-year period. China offers probably the most vivid illustration of this as several areas along the coast (in Zhejiang or Shandong) have actually registered a sizeable *decline* in sex ratio during the 1990s: these distinctive areas where the decline between 1990 and 2000 was of more than 5 boys per 100 girls are shown on the map with a dotted contour (Figure 5). This reverse trend is similar to what has been recently observed in South Korea (Kim, 2005). At the same time, sex discrimination has clearly intensified in contiguous provinces such as Jiangsu or Anhui.

In India, no significant improvement in child sex ratio is perceptible as most districts did record at least a slight increase in child sex ratio during the 1990s. However, the surge has been acute in the western states (Punjab, Haryana, and Gujarat) and appears much clustered in geographical terms. Elsewhere, the change has been far more modest and seems to proceed at a much slower tempo, with the notable exception of parts of coastal Orissa.

Changes in child sex ratio have therefore not been evenly distributed within both countries. Consequently, it is difficult to interpret the increase observed in China and India as a mechanical consequence of broader, structural trends affecting all regions equally. The regional factor seems much more significant in describing the pattern of change

that has occurred and there is a need for local explanations of the increase in sex ratio rather than wide-ranging explanations (such as economic, social and demographic change).

Figure 5 Change in child sex ratio (0-4 years) in 1990-2000, East China, computed from census county data



The influence of fertility decline or of rapid economic development on discriminatory behaviour should probably be understood within local contexts: this means that responses to new social and economic opportunities are mediated by local factors such as cultural value systems or bureaucratic institutions. As the observed increase tends to be clustered around pockets, the analysis further suggests the specific role that might be attributed to propagation mechanisms in regional change. Firstly, discriminatory practices tend to gradually spread across all social groups irrespective of community or class within given localities. But secondly, the influence of core areas -where girl discrimination is widely practised and socially acceptable- makes

itself felt on adjacent regions: this proves to be a crucial mechanism to explain how areas with high sex ratio tend to expand over the years as can be seen on our maps. But once again, the demographic billionaires seem rather different on that account because of the respective role of political structures in China and of larger social and cultural regions in India.

Figure 6 Change in child sex ratio (0-6 years) in 1991-2001, India, computed from census district data.

4. Discussion

Several unresolved issues remain about the causes of the sex ratio differentials observed in these two countries, but it is important to stress at the outset that the impact of fertility decline on the expression of son preference is in no way automatic: among early decliners, fertility decline in many regions caused little impact on the sex composition of the child population.[7] This is true of several regions of India such as

[7] On regional fertility decline in China, see King (2007).

Kerala or Andhra Pradesh where the fall in birth rates has not been accompanied by a gradual increase in the proportion of boys. Likewise, there are a few Chinese provinces such as Jiangsu or Tianjin where low fertility is not associated with increased discrimination towards girls as compared to adjacent provinces exhibiting high sex ratio. When examined more closely, several areas in the interior such as Anhui, Henan or Jiangxi, where sex ratio has reached levels above 135 boys per 100 girls, are rural or peri-urban and do not necessarily coincide with the lowest-fertility zones. Furthermore, our analysis has indicated that the average child sex ratio has slightly improved in some highly urbanized and more prosperous areas such as in the Beijing or Shanghai regions.

The persistent difference in the geography of child sex ratio refers to the specific interplay of traditional and government institutions in gender arrangements prevailing in both countries. While the Indian pattern can be broadly interpreted through a combination of local traditional institutions favouring patriarchal values and of rapid, economy-driven modernization processes, there are probably distinct diffusion mechanisms that helped new sex selection techniques and modern gender bias to spread from core areas to adjacent districts. To some extent, India exhibits a textbook example of demographic *laissez faire* in which established local institutions and dissemination processes are by and large responsible for the ultimate shape of demographic outcomes. On the contrary, the determinants of sex ratio differentials across China are less easily understood as closer examination indicates that *Han* China itself is still very heterogeneous with no clearly distinguishable anthropological patterns based on language or historical entities. Regional variations are much more likely to be caused by local party regulations and their impact on both demographic outcomes and statistical manipulations through channels described by Greenhalgh and Winckler (2005). But the confrontation of recent census data at different dates demonstrates the existence of spatial patterns that are rather stable over time on both countries. While this was expected for India, where census data have long revealed regional disparities, this result is important for China as the quality of reported data (such as female under-registration) was often mentioned as a possible source for distorted sex ratio values.

The examination of China's and India's sex ratio maps should help us to monitor the patterns of forthcoming change and to identify the hot spots where policy intervention is most urgently required. But our investigation also leads to a reappraisal of the recent deterioration of the sex ratio. The existence of firmly established spatial patterns for the phenomenon suggests that structural factors of demographic and economic change play a lesser role than the entrenched system of

patriarchal values. Patriarchy has clearly modernized over the last 30 years by absorbing some of the main ingredients of economic and demographic change such as fertility decline or increased monetization. However, its geographic contours have remained rather fixed and the impact of state intervention may remain limited, especially in the Indian case, if the root causes of son preference are not addressed.

References

ATTANÉ Isabelle, 2001, "Chinese fertility on the eve of the 21st century: fact and uncertainty", *Population, an English selection*, 13 (2), 71-100.

ATTANÉ Isabelle, 2002, "China's family planning policy: An overview of its past and future", *Studies in Family Planning*, 33(1), 103-113.

ATTANÉ Isabelle, 2004, "Zhongguo nanhai yu nühai bili shitiao de wenti yu qianzhan" ("The growing imbalance between males and females in China: issues and prospects"), in *Chinese Cross Currents*, Matteo Ricci Institute, Macau, bilingual edition, October-December 2004, 36-63.

CHAHNAZARIAN Anouch, 1988, "Determinants of the sex ratio at birth: Review of recent literature", *Social Biology*, 35(3-4): 214-35.

CHEN Shengli, COALE Ansley, 1993, *Zhongguo ge sheng shengyu lü shouce, 1940-1990 (Fertility data for Chinese provinces, 1940-1990),* Beijing: Zhongguo renkou chuban-she, 215 p.

CHEN Wei, 2003, "Son Preference, Fertility and Induced Abortion in China", paper presented *Workshop on Population changes in China at the beginning of the 21st century*, Australian National University, Canberra, 10-12 December 2003.

CHU Junhong 2003, "Prenatal Sex determination and Sex-Selective Abortion in Rural Central China", *Population and Development Review*, 27(2), 259-281.

DAS GUPTA Monica *et al.*, 2003, "Why is son preference so persistent in East and South Asia?: A cross-country study of China, India and the Republic of Korea", *Journal of Development Studies*, 40(2).

FOTHERINGHAM S., BRUNDSON C., CHARLTON M., 2000, *Quantitative Geography, Perspectives on Spatial Data Analysis,* London: Sage.

GREENHALGH Susan, WINCKLER Edwin A., 2005, *Governing China's Population: From Leninist to Neoliberal Biopolitics*, Stanford, Stanford University Press.

GUILMOTO Christophe Z., OLIVEAU Sébastien, 2007, "Sex Ratio Imbalances among Children at Micro-Level: China and India Compared", paper presented at the *Annual Meeting of the Population Association of America*, March 29-31, New York.

GUILMOTO Christophe Z., 2005, "A spatial and statistical examination of child sex ratio in China and India" *in* Attané I., Véron J. (eds.), *Gender Discrimination in Asia*, Pondicherry: IFP-Ceped, 133-167.

GUILMOTO Christophe Z., KULKARNI P.M., 2004, "Les femmes, la caste et l'état. Cinquante ans de planification familiale en Inde" *in* GAUTIER A. (ed.), *Les politiques de planification familiale. Cinq expériences nationales*, Paris: Ceped , 25-74.

KIM Doo-Sub, 2005, "Changing Trends and Regional Differentials in Sex Ratio at Birth in Korea: Revisited and Revised", *in* ATTANÉ Isabelle, VÉRON Jacques (Eds), *Gender Discriminations among Young Children in Asia*, Pondicherry: Ceped-French Institute of Pondicherry, 227-251.

KING Katherine, 2007, "A Space-Time Model of Fertility and Development in China, 1982-2000", paper presented at the *Annual Meeting of the Population Association of America*, March 29-31, New York.

SCHARPING Thomas, 2003, *Birth Control in China 1949-2000. Population Policy and Demographic Development*, London and New York: Routledge Curzon.

UNITED NATIONS, 2006, *World population prospects, The 2006 Revision Population Database, United Nations, Population division*, on the website http://esa.un.org/

Annex 1 Abbreviations of province names used in China's regional maps

ANH	Anhui	HAI	Hainan	JGX	Jiangxi	SAX	Shanxi
BEJ	Beijing	HEB	Hebei	JIL	Jilin	SCH	Sichuan
CHQ	Chongqing	HLJ	Heilongjiang	LNG	Liaoning	TIB	Tibet
FUJ	Fujian	HEN	Henan	MGL	Inner Mongolia	TJN	Tianjin
GAN	Gansu	HKG	Hong Kong	NGX	Ningxia	TWN	Taiwan
GDG	Guangdong	HUB	Hubei	QGH	Qinghai	XJG	Xinjiang
GGX	Guangxi	HUN	Hunan	SAA	Shaanxi	YUN	Yunnan
GUI	Guizhou	JGS	Jiangsu	SDG	Shandong	ZHJ	Zhejiang

Guilmoto Christophe, Attané I.

The geography of deteriorating child sex ratio in China and India.

In : Attané I. (ed.), Guilmoto Christophe (ed.). Watering the neighbour's garden : the growing demographic female deficit in Asia.

Paris (FRA), Nogent-sur-Marne : CICRED, CEPED, 2007, p. 109-129.

ISBN 2-910053-29-6, 978-2-910053-29-6

Watering the Neighbour's Garden : the Growing Demographic Female Deficit in Asia : International Seminar, 2005/12/05-07