The Sex Ratio Transition in Asia

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RECENT DECADES have been characterized by a worldwide convergence in fertility levels, largely a result of the pace of demographic change in the developing world. Cases of regional deviations from the common demographic trajectory are interpreted as temporary signs of incomplete integration into the new social and economic order. With Asia's population a prime illustration of this successful integration, it is all the more surprising to observe the rapid increase since the 1980s in the proportion of male births in the region, a trend representing one of the most notable anomalies in contemporary demography.[1] The sex ratio at birth[2] (SRB) now exceeds 110 male births per 100 female births in many regions across Asia, while a large surplus of men is building up in China and India with as yet undetermined consequences.

This process of demographic masculinization has proceeded at a pace unprecedented in recorded history. The causes, future implications, and potential evolution of this phenomenon are the subject of debate. The rise in the sex ratio at birth may continue unabated for some time, especially since prenatal discrimination by sex in the form of sex-selective abortion may spread to those Asian countries that have been so far unaffected. On the other hand, the current trend has been reversed in South Korea and may be reversing in other countries. At this point, we may wonder whether social scientists who have observed many historical swings in population change—such as in disease patterns or migration streams—may be observing yet another manifestation of an archetypal transition cycle. This essay attempts to explore the implications of this notion.

I adopt a comparative perspective to review trends and determinants of SRB increase across Asia. I stress commonalities rather than detailing the particular circumstances in which gender-based discrimination manifests itself. This comparison provides the basis for a comprehensive framework to interpret the recent rise in sex ratios at birth and to identify specific transition patterns in SRB trends.

Trends and variations in the sex ratio at birth across Asia

While it is clear that, over the last several decades, the sex ratio at birth in several Asian regions has risen above the normal level of approximately 105, comparative data are not readily available. According to estimates by the Population Division of the United Nations for 1950–2005, the SRB in most countries lies within the range of 104–106. A few Asian countries are credited, however, with distinctive SRB trajectories in which higher ratios start from a moderate value in the early 1980s, increase thereafter, and are projected to peak at levels between 110 and 120 by the 2010s and then to fall below 110 before 2050. With the exception of India, where the actual and projected SRB remains at 108 from 1990 onward, all such trajectories consist of a sudden rise occurring after 1990, followed by a plateau for a decade, and a gradual decrease thereafter. According to these estimates, all affected Asian countries are presently at their highest-ever level of the sex ratio at birth.

Table 1 presents sex ratios for countries in which the presence of high levels (above 106) can be established.[3] Figures are drawn from a variety of sources and refer mostly to the years 2004–08. Three types of sources are brought together here: birth registration, which is by far the most appropriate source when available;[4] birth-history estimates from large surveys; and census data on recent births or age. While the best indicator remains the SRB, I also make use of the child sex ratio (SR04)—an indicator that is also influenced by mortality differentials—when no SRB data are available for recent years or when such data are plainly unreliable.

The Asian countries analyzed belong to three regions: East Asia (China, Taiwan, Singapore, and Vietnam), South Asia (Pakistan, India), and West Asia (Armenia, Azerbaijan, and Georgia), to which I added Albania, the only non-Asian country in which a recent SRB increase could be ascertained.[5] I have not included neighboring countries where the sex ratio at birth has remained normal: Turkey, Iran, Sri Lanka, Japan, Thailand, Malaysia, Philippines, and Indonesia. Whenever relevant and feasible, I present regional estimates for selected Indian states and Chinese provinces.

I also examine annual SRB series for three countries with reliable civil registration statistics: Azerbaijan, South Korea, and China, although the last yields a probably less reliable series.[6] These data (annual estimates and three-year moving averages) for 1970–2007 are shown in Figure 1.

East Asia

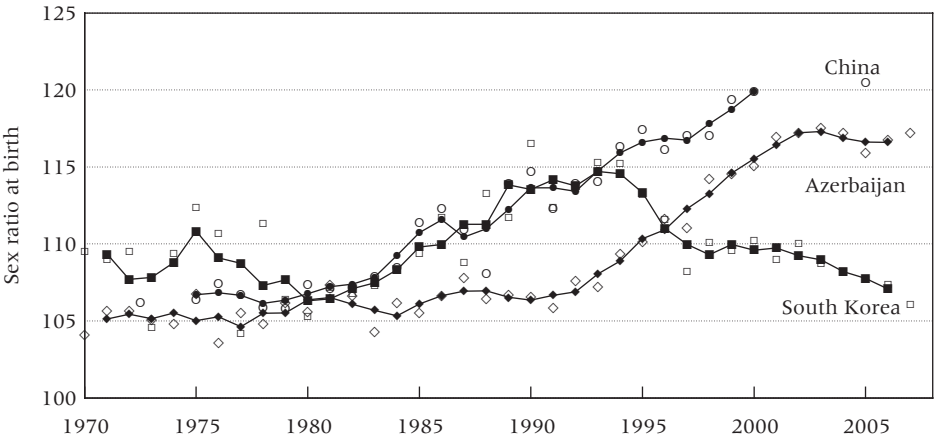
Annual series in Figure 1 indicate that the rise in SRB started almost simultaneously in South Korea and China and followed a similar course in the two countries during the first ten years. Dating the onset of this increase is difficult in view of past fluctuations in SRB levels, but 1980 can be taken as a turning

TABLE 1 Recent measurements based on various sources of the sex ratio at birth and of the child sex ratio in countries and country subregions of Asia and Europe, 2000–08

Country/region	Indicator	Sex ratio	Reference date	Data type
Albania				
Entire country	SRB	114.2	2006	Civil registration
Entire country	SR04	109.2	2006	Age structure
Armenia				
Entire country	SRB	115.1	2007	Civil registration
Entire country	SRB	121.3	2001–05	DHS
Azerbaijan				
Entire country	SRB	116.0	2005	Civil registration
Entire country	SRB	120.3	2002–06	DHS
China				
Mainland	SRB	120.5	2004	1% survey
Rural areas	SRB	122.9	2004	1% survey
Jiangxi	SRB	137.1	2004	1% survey
Anhui	SRB	132.2	2004	1% survey
Shaanxi	SRB	132.1	2004	1% survey
Hubei	SRB	127.9	2004	1% survey
Hunan	SRB	127.8	2004	1% survey
Guizhou	SRB	127.6	2004	1% survey
Hong Kong	SRB	112.0	2007	Civil registration
Taiwan	SRB	109.6	2007	Civil registration
Georgia				
Entire country	SRB	110.1	2007	Civil registration
Entire country	SR04	111.9	2008	Age structure
India				
Entire country	SRB	109.0	2000–06	NFHS-3 survey
Entire country	SRB	112.1	2004–06	Sample Registration System
Punjab	SRB	123.8	2004–06	Sample Registration System
Haryana	SRB	120.9	2005	Civil registration
Delhi	SRB	118.0	2007	Civil registration
Gujarat	SRB	114.7	2006	Civil registration
Rajasthan	SRB	120.7	2006	Civil registration
Rajasthan	SRB	114.8	2004–06	Sample Registration System
Uttar Pradesh	SRB	114.4	2004–06	Sample Registration System
Pakistan				
Entire country	SRB	108.9	2003–07	DHS
Entire country	SRB	112.0	2005	PDS survey
Singapore				
Entire country	SRB	107.2	2007	Civil registration
South Korea				
Entire country	SRB	106.1	2007	Civil registration
Vietnam				
Entire country	SRB	111.0	2006	2007 survey of births
Entire country	SRB	112.0	2007–08	2008 population survey
North Central region	SRB	113.5	2006	2007 survey of births
Red River Delta	SRB	113.0	2006	2007 survey of births

Indicator: SRB = sex ratio at birth; SR04 = sex ratio below age 5 years.
SOURCE: Described in the Appendix.

FIGURE 1 Sex ratio at birth in Azerbaijan, China, and South Korea, annual variations and three-year moving averages, 1970–2007



SOURCE: Described in the Appendix.

point. The rise may have started earlier in specific subpopulations as suggested by the case of Singapore, where the SRB among births with Chinese fathers rose during the 1970s (Graham 2007). South Korea reached a level of 115 in 1990, as did China in 1994. But then the trends diverged. The SRB in South Korea plateaued at 114 in the early 1990s, followed by a gradual reduction. This downward trend continued, and the latest South Korean figure of 106 in 2007 is within the normal range. Comparing the annual rate of change in SRB during both the upward and downward phases in South Korea, the decline appears to be somewhat slower at –0.6 per year after 1994 than the pace of the initial rise of 0.8 per year during the 1980s.

The sex ratio at birth in China rose well over the 115 mark during the 1990s and to 120 in 2000. The most recent figure based on births during the year prior to the 2005 sample census suggests a ratio leveling off at 120.5. Chinese SRB data, however, are regarded as questionable in view of underenumeration of births and discrepancies in published tabulations. Despite many confirmations of the declining proportion of female births, available estimates drawn from limited data sources may not capture the true SRB in China's provinces.[7] China's SRB levels are extremely high in such provinces as Jiangxi and Anhui, while levels are lower in western provinces and metropolitan areas such as Beijing, Tianjin, and Xinjiang.

Elsewhere in East and Southeast Asia, SRB levels have remained stable at levels around 105–106, as evidenced by detailed statistics from Japan, Thailand, and Indonesia. The only exception is Vietnam. Despite a history of son preference, no rise in Vietnam's SRB was perceptible until the beginning of the twenty-first century. The sex ratio at birth, however, is now on

the rise and reached 111 in 2006, with slightly higher figures observed in the prosperous rural delta region in the North (Bélanger et al. 2003; Guilmoto et al. 2009).

South Asia

In the absence of adequate civil registration data, the rise in SRB cannot be monitored annually in South Asia. In India, child sex ratio figures derived from the 1991 census highlighted a rise that took place during the 1980s, and qualitative studies offered evidence of the appearance of the practice of sex-selective abortions. A confounding factor is the regional variation in prenatal sex discrimination, which results in a moderate national SRB average around 113 (Kulkarni 2007). In some regions, mostly in Northwest India, the sex ratio rose continuously at a pace similar to China's and reached values above 120 at the turn of the century. The SRB started to rise later in some other regions of India. Again, as in China's highest-SRB provinces, many smaller areas within Punjab and Haryana have registered extremely elevated sex ratios in the range of 130–150. At the same time, sex ratio levels have shown no sign of increase in many other Indian states, whether in the more developed areas in the South or in impoverished regions in central India.

Evidence of increasing masculinity of the SRB in other South Asian countries is scarce, despite well-documented discrimination against girls in many areas. The recent PDS and DHS demographic surveys in Pakistan have indicated sex ratios in the range of 109–112 for 2003–07, but the lack of other census and registration data precludes a more detailed regional picture. While Sri Lanka, like most of South India, shows no evidence of prenatal sex selection, with SRB values below 105, Bangladesh and Nepal might soon join the list of countries with rising sex ratios at birth.

West Asia

The Caucasus offers an interesting case as the proportion of male births did not rise substantially before the 1990s. Data from Azerbaijan indicate that the SRB had increased only slightly from 104 to 106 between 1965 and the late 1980s. A sharp rise in the SRB dates from 1992, the year following the country's declaration of independence from the Soviet Union. The pace of increase at 0.9 points per year was exceptionally rapid, but the ratio leveled off at 117 in 2002. While this development may appear atypical, it is part of a well-established pattern of rapidly increasing SRBs in all newly independent countries of the South Caucasus. It paralleled the rise observed in Georgia and Armenia after independence. In Georgia, where the rise was the fastest, the sex ratio at birth reached 119 in 1998.[8] Available series from Armenia tell the same story, as the sex ratio of the population below one year reached 116 in

the 2001 census and has shown ups and downs since then. When available, estimates from the Demographic and Health Surveys provide independent confirmation of these elevated SRB levels.

The South Caucasus is a linguistically and culturally highly diverse region.[9] But the end of Soviet rule in these three countries, accompanied by significant fertility decline, seems to have set in motion the same demographic manifestation of son preference, characterized in particular by especially high SRBs among third births (Meslé et al. 2007). Comparison with other former Soviet republics indicates that almost no country from Eastern Europe to Central Asia recorded a sizable increase in the SRB and that slightly elevated SRB levels are found only in the Caucasian part of the Russian Federation bordering Georgia and Azerbaijan. The one exception is Albania, where the SRB began rising in the 1990s, with levels above 114 recorded after 2000.[10]

A sex ratio transition

Before I turn, in the next section, to the factors behind the shifting demographic balance of the sexes, the discussion to this point allows an outline of the patterns of SRB change. The recent rise in SRB observed across Asia resembles a diffusion process similar to that sometimes claimed to characterize the pattern of fertility decline. In such a framework, sex-determination technology (ultrasonography and amniocentesis) is the key innovation that permits couples to resort to sex selection in a context characterized by declining fertility and entrenched son preference. Sex-selective abortion was first adopted by "pioneer groups" as a response to the fertility predicament common in Asia: reducing the number of children while maximizing the probability of having at least one son. As in many cases of diffusion of innovation, forerunners were initially mainly urban, well-to-do, and better-educated. Urban elites were the first to get information on and access to the new sex-selection technology.[11] The fast-rising sex ratio at birth observed after a few years followed the diffusion of this new sex-selection strategy to new groups and to neighboring regions. This was made possible by the spread of information; the widening supply of the technology, mostly through private health care facilities; and the declining cost of ultrasound machinery. Regional maps demonstrate the gradual diffusion of high sex ratios across affected countries (Guilmoto and Attané 2007; Kim and Song 2007).

The first phase of this diffusion is far from exhausted. But the trend toward higher SRBs appears to be leveling off and beginning to reverse in several settings. Such a transition pattern is illustrated by South Korea, where it is possible to monitor annual variations since 1980. The SRB rose above 115 around 1990, leveled off during the mid-1990s, and then began a steady decline. The latest SRB (106 in 2007) suggests that the transition is virtually complete. Within-country variation is substantial: the SRB exceeded 120 in Taegu city and in Kyongbuk and Kyongnam provinces, whereas other regions

in the south-western side of the Korean peninsula showed little rise in SRB. These regional differentials have been related in part to the population's religious composition, but there is a distinct spatial pattern as well (Kim and Song 2007). Additional data on sex ratio decline in South Korea illustrate the diffusional nature of this transition process: the sex ratio rise started among more advanced strata of society—tertiary-sector workers and the college-educated—a few years earlier than among the rest of the population. The inception of the transition probably started in the late 1970s among these pioneer groups, but the SRB among these groups also plateaued earlier and at a lower level, and started to decline before 1990. In comparison, the SRB transition among manual workers and the less educated began later, peaked at a higher level, and started its diminishing phase only in 1995.[12]

Other Asian countries show signs of stalling or of downward trends in sex ratios.[13] In China, the SRB declined appreciably in 2000–05 in the contiguous Southeast provinces of Guangdong, Hainan, and Guangxi. In other areas, the sex ratio at birth has leveled off. When disaggregated, data point to distinct regional trajectories contrasting core areas of East China with interior regions where the SRB started to rise later. In addition, SRB levels have leveled off in Taiwan over the last few years and have almost returned to normal in Singapore.[14]

Downward trends are not restricted to China and South Korea. In India, where the SRB had increased most rapidly in Punjab, it seems to have reached a peak of 133 at the turn of the century, after which a slight decline is discernible. Similarly, in Delhi, where birth registration data are available over a long period, the SRB continuously increased from the 1990s to 2001 when it reached 124. Since then, the SRB has diminished slightly and was estimated at 118 in 2007. In Gujarat, Rajasthan, and Haryana, figures from civil registration and from the Sample Registration System also point to a slow SRB decline. Interestingly, the turnaround appears to have been mostly confined to urban areas. For instance, SRB levels have, on average, declined annually by 2 points in urban Punjab and Haryana during 2000–05 according to the SRS series.[15]

Since the turn of the century, SRBs have also apparently leveled off or are declining in the three Caucasian countries. Differences within Azerbaijan are also apparent. The SRB rose more rapidly in urban areas (dominated by the capital city of Baku) than in the countryside, and there is a time lag of about four years between urban and rural SRB levels. But according to the latest civil registration figures, the SRB in Azerbaijani towns is gradually decreasing, down from 120 in 2003 to 116 in 2006.

This review of SRB trends shows many instances of leveling off or downward trends since 2000. This resembles the typical pattern of a transition phenomenon. During its first phase, the SRB increases according to classic diffusion mechanisms originating mostly from high-density urban areas or from prosperous, better-educated strata of society. A complete transition pattern

as illustrated by South Korea would further indicate the reversible character of the process: a gradual return of the sex ratio at birth to biologically normal levels during a second phase.

Viewed in this way, the sex ratio transition remains a conjecture based on partial observed patterns of SRB trajectories. To better understand the structural or endogenous factors that may account for this anticipated SRB reversal, I turn to a discussion of the social and economic conditions across Asia that led to the rising sex ratios at birth in the first place.

Determinants and underlying causes of sex imbalances at birth

In part because of data limitations, the roles of potential determinants of observed imbalances by sex at birth—voluntary or involuntary under-registration of female births, biological variations in sex ratio at birth, induced abortion, mortality and differences by sex in rates of infanticide—have long blurred understanding of the rising proportions of boys within the total number of births. The prominent role of sex-selective abortions in the process has been only slowly acknowledged. But recognition of the proximate causes of rising sex ratios at birth still leaves unidentified the common elements accounting for the almost simultaneous shifts in SRB observed in several Asian countries.

Deliberate sex selection in the populations practicing it can be considered neither socially aberrant nor a legacy of an archaic mindset. From the actors' point of view, discrimination against unborn girls emerges as a rational strategy in response to changing constraints and opportunities within existing gender regimes. The causal processes at work may be conceptualized by using the classic framework introduced by Ansley Coale for explaining fertility decline in Europe.[16] Coale posited three main preconditions for fertility decline: fertility limitation has to be within the "calculus of conscious choice"; parents must have good reasons to want to limit births; and the methods to achieve limitation have to be available to them. We adapt these prerequisites to sex selection by saying that parents have to be able, willing, and ready to practice sex selection. The first precondition sounds straightforward: availability of enabling technology is an indispensable ingredient for adequate sex selection. But this aspect entails many independent conditions, such as the effectiveness, cost, material accessibility, and legal environment that affect people's ability to manipulate the sex composition of their offspring. The next two preconditions, as proposed by Coale, can be put in the form of a single question: are people willing and ready to practice sex selection? Social conditions related, for instance, to the ethical or religious context may allow parents to engage in sex selection or may discourage it. Some aspects of sex selection (notably the recourse to abortion) may be objectionable to them.

But even more importantly, people will not be ready to practice sex selection unless they anticipate distinct benefits from their choice. Even when sex selection is both accessible and acceptable, it will not be practiced in the absence of entrenched sex preference.

These two conditions of ability and readiness correspond to the supply and demand framework extended to explain personal choices. But we need to add a third factor typical of low-fertility situations in which deliberate sex selection substitutes for additional childbirths as the easiest solution to the achievement of gender goals. This factor is the so-called fertility squeeze. I now discuss the nature of these three preconditions for sex selection.

The technology-driven revolution in gender discrimination

One of the most common explanations offered for the present gender imbalances in Asia concerns the progress of technology. The growing ability of families in Asia to influence the sex composition of their offspring has indeed proved for the last three decades to be one of the main factors behind the rise in SRBs. But even though access to sex-selective abortions is today the main proximate variable of sex selection, many traditional methods that aimed at favoring the birth of sons existed also in the past.

Traditional methods. A number of age-old methods have been practiced with the intent to influence the sex composition of a family's children (Institute for Social Development Studies 2007; Bandyopadhyay and Singh 2007), and use of these methods is still reported today. Some are based on the belief that physical circumstances or divine intervention would ensure the "right" sex of the expected birth. Going on a pilgrimage or following a specific diet are two examples often mentioned by parents eager to have a child of a particular sex. Other ways thought to influence the sex of a child include prayer, the timing and type of intercourse, and meteorological or astronomical circumstances. Among Hindus, codified *pumsavana* rituals are performed during the second trimester of pregnancy to beget sons. But even if pointing to clearly defined sex preferences, these prenatal folk methods were of no demonstrated effectiveness and thus left no tangible trace on the sex composition of a population.

Other remnants of the "old discriminatory regime" have not disappeared, in spite of the emergence of modern methods of prenatal sex selection.[17] One of the oldest methods to alter the sex composition of children is also the crudest, namely female infanticide. The practice has long been reported in Asia, and it has not yet entirely vanished from some countries. Infanticide's effectiveness is beyond doubt, and its financial cost is also extremely low. But it presents many drawbacks and dilemmas, especially the distress caused to mothers. Poverty alleviation and the enforcement of crimi-

nal laws have contributed to the reduction of infanticide in contemporary Asia to presumably very low levels. Female abandonment is another solution to get rid of unwanted daughters, but abandonment and adoption are less common in Asia than elsewhere.

Neglect of girls, however, is far more common in Asia. It corresponds to a passive strategy to deprive girls of their fair access to and share of household resources. This bias results in excess mortality among girls that is still pronounced in China and Northwest India and directly affects juvenile sex ratios. According to the United Nations Population Division, female mortality below age 5 years in 2000–05 is higher than male mortality in only a few countries in the world, among which are Nepal, Pakistan, and India. China, however, stands apart with a record excess female mortality estimated at 42 percent above male mortality in the below-5 age group (see also Banister and Hill 2004). Factors related to excess female mortality include deprivation related to postnatal care, proper clothing, parental surveillance, breastfeeding, food allocation, recourse to health facilities, immunization, and so on. Nevertheless, such discriminatory behavior against girls does not invariably cause mortality, and most Asian girls survive childhood even if subject to such discrimination. Neglect can therefore be seen as a "low-technology method": while it requires almost no financial or other effort from parents, its effectiveness in determining the sex composition of offspring is limited.

Differential contraception and high-technology methods. One of the oldest means to adjust one's fertility with respect to the sex of one's children is to avoid further births once the ideal family composition is attained. The introduction of modern family planning methods in many Asian countries from the 1960s onward has enabled parents to achieve this goal in a more efficient manner by giving them adequate methods to stop childbearing. This practice has often been described in the literature as the "stopping rule," whereby parents of sons avoid additional births in greater proportions than do sonless parents.[18] While undoubtedly more effective in preventing unwanted births than previous birth control methods, this strategy assumes that sonless women are prepared to undergo additional pregnancies to give birth to a son.

Prenatal sex selection relies on the combination of one of two diagnostic techniques that appeared in the 1970s—amniocentesis and ultrasonography—followed by elective abortion.[19] It is difficult to trace the precise date of their mass introduction in Asia, but scientific research in China related to ultrasonography was underway in the late 1950s, only to be seriously slowed by the turmoil of the Cultural Revolution. In the 1970s, China developed its first ultrasound equipment for pregnancy monitoring, and thousands of such machines were either manufactured in China or imported to be installed in family planning stations and clinics over the next decade. The trial introduction of amniocentesis in India in the mid-1970s immediately led to women aborting unwanted female fetuses. Ultrasound was introduced a few years

later. By the 1980s, hundreds of clinics offering amniocentesis or ultrasound services were already in operation in China and India to cater to the needs of parents anxious to know the sex of their child and likely to abort female fetuses. In many other Asian countries, for example Vietnam, ultrasonography appears to have been introduced later.

More recently, more sophisticated sex-selection techniques such as pre-implantation methods and fetal blood testing have been developed.[20] But these techniques are expensive and require access to a well-equipped laboratory. For a variety of reasons, including cost and legal prohibition, they are not yet readily available in Asia.

Abortion, the other ingredient in modern sex selection, has long been legal in many Asian countries. In China, India, and South Korea pregnancy termination has been authorized respectively since 1957, 1971, and 1973. Likewise, former Soviet republics in West and Central Asia have long had liberal legislation on pregnancy termination. Elsewhere abortion has been legalized only recently (e.g., Nepal in 2002) or remains limited to life-saving situations (Bangladesh, Indonesia, Myanmar, Philippines). This does not mean, of course, that abortions do not take place in these countries, but rather that these illegal procedures are often conducted in unsafe conditions. It should also be noted that in Asia as elsewhere a very large proportion of pregnancy terminations take place before the second trimester of pregnancy, when prenatal diagnosis is unfeasible. These abortions are aimed at limiting or spacing births rather than at sex selection.

The advantages of prenatal sex selection are clear: women are spared months of pregnancy, and selection procedures are performed under medical control and are relatively safe as long as the abortion is performed by trained practitioners. Sex-selective abortion looks more "modern" and "rational" as well (Varma 2002; see also Gammeltoft et al. 2007): not only is it seen as part of modern health care provision, it also reflects women's capacity to anticipate the consequences of a female birth from the beginning of pregnancy. The effectiveness of the method is virtually absolute. An additional advantage is that early pregnancy can often be concealed from social monitoring, and may be known only within the family: collective surveillance—be it by local officials or community members—is weakened, and decisions can be taken based on discussion with relatives, such as the husband or his family.

Technological diffusion and control. The availability of sex-selection methods is mediated first by knowledge and awareness of their existence. Traditional methods had long been in place and were therefore well known, with local specialists responsible for preserving specific know-how (such as plants causing abortion or ways to dispose of infants). New methods, such as sex-selective abortion, were, however, unknown 30 years ago and required specific infrastructures. For instance, the recent rise of the SRB in Vietnam is closely linked to the introduction of ultrasound facilities in private clinics and hos-

pitals (Gammeltoft et al. 2007). It is also likely that very few health centers in countries like Myanmar, North Korea, and Afghanistan offer good-quality ultrasound facilities.

The new sex-selection strategy spread in several Asian countries through various channels, ranging from word-of-mouth to aggressive publicity by suppliers. Because of the proximity of the two ingredients of sex-selective abortion—sex identification and pregnancy termination—to family planning and reproductive-health care, these two procedures benefited from wide publicity, either as a component of modern prenatal care or as a part of fertility-control methods. Moreover, the fact that modern methods of sex selection could be offered not only in large hospitals, but also in small health centers such as private clinics or local public dispensaries contributed to their wide diffusion across urban and then rural Asia. In many countries, a boom in private health care and the growing purchasing power of the expanding middle classes were decisive in the spread of the new technology.

Legislation, however, is becoming a central part of the supply side in several Asian countries. I have already mentioned its role when describing the various regulations related to abortion in Asia, ranging from strict prohibition to extremely liberal policies. An additional factor is the introduction of laws to check sex-selective abortion of fetuses. Regulations were introduced early on in South Korea, China, and India, although they were incompletely enforced.[21] Stricter implementation of existing laws and new legislation represent a significant shift in the supply side of the equation, as I examine further below.

The need for sons

Understanding the rationale behind sex preference is key to deciphering the dynamics of the sex ratio in Asia and what Miller calls "patriarchal demographics" (2001: 1086). The literature on sex preference and gender discrimination has grown in recent decades. In this section, I describe the circumstances that make sex selection socially acceptable and the reasons why the birth of a son is perceived as being more "rewarding" than that of a daughter.[22]

No philosophical or religious principles formally bar individuals or groups in Asia from influencing the sex composition of their offspring. But methods to achieve sex selection may be rejected, as is obviously the case for infanticide, a practice morally condemned everywhere. Abortion remains a very sensitive matter for many mothers, including in countries like China where it is widely practiced (Nie 2005). In some religious communities—such as among Christians or Muslims—abortion is discouraged or condemned, and sex ratios are closer to normal levels among these groups, accounting for perceptible differences within countries like South Korea and India.[23] But religiously sanctioned rules are often ignored, as is illustrated

by the high prevalence of abortion in such countries as Korea and Japan, where strict traditional Buddhist norms would be expected to prohibit it (Keown 1999).

The most common explanation for gender discrimination is the economic argument that girls are not as "cost-efficient" as boys. Raising a girl is often seen as a source of additional expenses related only to daughters. In South Asian countries, for instance, girls are perceived to be especially vulnerable, as family honor rests to a large part on women's behavior rather than on men's. Costs arising during and after their marriage cause daughters to appear especially "expensive" compared to sons. And costs incurred during the wedding and the institution of dowry make marriage expenditures highly asymmetrical because of the dowry paid in kind or in cash by the bride's family to the groom's, which often also includes post-marriage transfers. A high dowry ensures a marriage into the best possible family—hypergamy being a tacit norm—and bestows prestige and reputation on the bride's family. Dowry arrangements, long common among high-status groups, have now spread to most other segments of society in South Asia. In East Asia, in contrast, dowry amounts are lower, and the reverse practice of bridewealth is common in many areas such as rural China.

In areas or communities characterized by joint family arrangements, resources are usually pooled between parents and children. But the Asian pattern is strongly patriarchal and mostly patrilocal: married women are expected to live with, or close to, their parents-in-law. As a result, income from married sons, who often work with their father, and from daughters-in-law will directly accrue to the parents. Multi-generational solidarity also means that parents may enjoy constant financial, emotional, and other kinds of support from their married sons' families. Where pension benefits and social security are nearly absent, except for a small fraction of the urban population, long-time support extended primarily by sons is a major source of security for aging parents. Sons are rewarded by inheritance rules that are biased in their favor.

The advantage of sons extends to non-financial domains. Sons are a source of protection and special affection for parents. Having several sons in rural China strengthens family power within the clan or vis-à-vis rival clans. Symbolic advantages in having sons include preservation of the family and the clan and the role of sons in rituals on behalf of ancestors or during funerals—tasks from which women in Asia are customarily excluded. Daughters are expected to live away from their parents and to have limited interaction with them after marriage. Socially and economically, raising sons is a much more sound option than raising daughters ("watering your neighbor's garden"). Each cultural setting is replete with customs and sayings celebrating the birth of sons and lamenting the arrival of daughters.

The independent role played by a specific aversion to daughters (apart from son preference) should also be noted. In contexts where the birth of a

girl adds to the burden of the community or the family, discrimination against girls may be more closely related to status or economic reasons (such as hypergamy, dowry costs, etc.) than to a distinct desire for sons. This was the case in Asian settings in which many girls in the past were either killed or abandoned after birth at a time when fertility was relatively high and sex-selection options were primitive.[24] But sorting out the respective weight of broader preference for boys and more specific aversion to girls remains difficult.

A word of caution is required when applying a narrowly utilitarian cost–benefit analysis to the differential gender valuation of a birth of a child according to sex, since the motives that underlie it are only partly economic. The distortions caused by inherited social institutions, which lie at the root of the patriarchal system, significantly alter the pure rational-choice framework favored by economists. Many cultural constraints typical of local gender arrangements, such as virilocality, dowry, or discriminatory inheritance rules, have a limited economic rationale. The "readiness" precondition should therefore be seen as a blend of age-old traditions and gender-based economic asymmetry.[25]

The fertility squeeze

The third major component of the motivation for sex selection relates to fertility decline and its impact on the composition of children in a family by sex. Table 2 illustrates this by showing the probability of various events in relation to fertility level (i.e., sex-blind fertility). Even if mortality is factored in, few people fail to give birth to a son in a high-fertility regime. But the first row of Table 2 shows the fast-increasing probability of being sonless when fertility diminishes. Rapid fertility decline may not have exacerbated the need for sons so much as the risk of remaining sonless.

The next row in the table indicates the maximum acceptable proportion of female births if parents are to have at least one son, a proportion that decreases sharply as fertility declines to very low levels. Without recourse to

TABLE 2 Fertility and family composition by sex

	Average number of children						
	6	**5**	**4**	**3**	**2**	**1.5**	**1**
Probability of being sonless (%)[a]	1	3	6	12	24	34	49
Acceptable proportion of female births (%)[b]	83	80	75	67	50	33	0
Average additional births required to bear a son (%)[c]	33	39	49	65	98	130	195

[a]Probability of female-only births.
[b]Highest proportion of female births acceptable to parents who wish to have at least one son.
[c]Average additional births (1.95) needed for sonless parents to bear a son, expressed as a percentage of average number of children.

prenatal sex selection, the average number of additional births necessary to bear a son is 1.95 children with a normal SRB of 105. Row 3 shows the "cost" of the additional births required for a male birth as the ratio of these 1.95 additional births to the ideal fertility. This marginal cost becomes prohibitive when, for instance, families with two children but no son may expect to have to bear another two children to ensure the birth of one son. Doing so, they would moreover end up on average with three daughters, an especially unwanted outcome if the aversion to girls (e.g., due to dowry costs or a fine for excess fertility) is as acute as the need for a son.

Such examples demonstrate the weakness of parents' reliance on the "stopping rule": the marginal cost of additional children in a low-fertility regime becomes untenable. If sonless parents were instead to resort to strict sex selection for their additional pregnancy, they would need only one more birth to reach their goal. The benefit of sex selection becomes obvious, and it should come as no surprise that the sex ratio at birth invariably increases with birth order. First births usually display normal or marginally skewed SRB levels. The ratio of higher-parity births, when sonless parents realize that they may end up with no sons, tends to be much higher. For instance, the SRB for western India has been estimated at 107 for first births, 110 for second births, and 114 for later births. Ratios for parity 2 and 3 would rise respectively to 115 and 132 among women with no living sons.[26] Similarly, data indicate a sudden rise in SRB among third births in South Korea during the 1980s and a decade later in the Caucasus (Park and Cho 1995; Meslé et al. 2007). As expected, this increase in parity-specific SRBs is exacerbated by very low fertility levels in which second-order births become less frequent. This is the case in China, where the SRB among second births exceeded 140 in 2005 while first-order births displayed near-normal SRB levels (Goodkind 2008).

Reductions in the average number of children create a "fertility squeeze" for parents seeking a son.[27] This constitutes an independent third precondition for active sex selection. The squeeze element is largely absent among populations with high fertility, who have less need for sex selection to ensure the birth of a son. In fact, if the low proportion of parents with no son were to practice strict sex selection for later births, the statistical impact of such behavior would be almost imperceptible.[28]

In addition to the effect of spontaneous fertility decline, forceful government fertility policies in China, and to a lesser extent in Vietnam, add to the marginal cost of additional children. This accounts in particular for the sharp rise in SRB observed in China from first- to second-order births. For a large part of rural East China, where a second birth was conditional on the first birth being a daughter, parents' sex preference has in fact been incorporated in population policy.[29] This provision, in itself a vivid manifestation of gender discrimination, derives from the recognition by Chinese authorities of the acute demand for a male descendant among peasants and other rural

households. The wider dilemma faced by both families and governments in order to achieve low fertility at the expense of female offspring and gender equity resulted in China's "gendered families" (Greenhalgh and Winckler 2005). Such a situation goes a long way to explain governments' indifference in many Asian countries to the growing resort to sex-selective abortion by households trying to meet simultaneously their preference for the composition of their children by sex and their preferred or government-imposed fertility requirements.

Many commentators initially blamed China's strict family planning regulations for reported cases of infanticide and sex-selective abortions. This is a somewhat narrow-minded explanation in view of the simultaneous rise in SRB in Taiwan, South Korea, and India's Northwest region, where no similar population policies were implemented, as well as among the Asian diaspora in the West (Douglas and Edlund 2008; Abrevaya 2009). But whatever its local political context, given sex-differential parental preference for children, fertility decline reinforces the need for sex selection everywhere by discouraging the use of the age-old strategy of trial-and-error through repeated pregnancies.

As the pressure to abort female fetuses rises when fertility preferences decrease while preference for male offspring persists, we may think of a threshold level at which low fertility would automatically create a fertility squeeze. For instance, an average of 24 percent of parents with two children will remain sonless (Table 2): one may imagine that such a threshold would correspond to a specific level of active discrimination against girls. But SRB data fail to confirm such a mechanical link. To test whether given fertility levels could be associated with the inception of widespread sex selection, I have estimated the fertility levels in various countries (and regions) in the year when the SRB crossed the 110 threshold.[30] In India as a whole, the TFR was 3.8 when the SRB reached 110 in 1990 and well above 4 in Punjab (in 1981), Rajasthan (in 1991), and Uttar Pradesh (1998). But in China, the TFR was comparatively low at 2.3–2.5 (in 1985), and even lower in provinces such as prosperous Beijing, where the SRB exceeded 110 only in 1999. In South Korea (in 1986) and in Taiwan (in 1990), fertility was around 1.75. In the three Caucasian countries, where the SRB reached 110 in unison in 1995, fertility levels ranged from 1.8 in Georgia to 2.5 in Azerbaijan.[31]

The absence of a strong link between level of fertility and rising SRBs serves as a reminder that fertility per se is not the only predictor of gender discrimination. While low fertility exacerbates demand for sex selection, many other factors are also at play.

Synthesis

To this point I have discussed the main factors associated with the three preconditions for prenatal sex selection: access to modern sex-selection technol-

ogy with liberal abortion legislation (*able*), moral acceptance of sex selection and a socially grounded preference for sons (*ready*), and low-fertility pressure (*squeezed*). In practice, identifying the weakest factor is often enough for understanding the absence of pronounced sex selection in various settings. We may, for instance, explain the case of Iran or Thailand by the lack of son preference, that of Vietnam before 2000 and possibly of Caucasian countries before 1990 by the near absence of efficient prenatal diagnostic methods, and the cases of Nepal and Afghanistan by a weak fertility squeeze effect because of still-high fertility levels.[32]

The proportion of male births, when above normal biological levels, thus may be determined by one factor or a combination of factors.[33] Comparing the distribution of SRB values in Asia, we may presume that son preference played a considerable role in Northwest India. In fact, as I have shown, the SRB reached exceptionally high levels in this region as soon as modern sex-selection technology emerged, but long before fertility dropped to replacement level. The bias against daughters must have been very strong to explain such a rapid diffusion of sex-selective abortion in this part of India. By constrast, stringent fertility regulations in rural China must have had a determining effect on discrimination by sex of the fetus. Lack of adequate data to capture these components precludes a more detailed decomposition of the kind undertaken by Lesthaeghe and Vanderhoeft (2001) for fertility decline, but subsequent research should evaluate these distinct dimensions in order to assess potential risks of sex selection in still unaffected areas with biased gender preference.

Why would sex ratios at birth return to normal?

Recent statistics suggest that the rise in the sex ratio at birth may soon come to a halt in some areas. It may be expected that the social and economic pressure for gender discrimination will diminish over time in many areas with high sex ratios at birth. Growth in human capital and economic opportunities gives women greater autonomy and economic self-reliance, and may undermine the foundations of a patriarchal system based on their submission and exploitation. These gains contribute to a rapid weakening of male-based tradition and customs and to the promotion of more gender-symmetrical family arrangements.

Many changes are underway concerning male-biased rituals (such as the cult of ancestors), marriage transactions, and inheritance patterns that bear the marks of the patriarchal system.[34] Traditional joint-family arrangements are also becoming less frequent in rural China and elsewhere. The role played by daughters in old-age support is growing in spite of traditionally patrilineal family systems. The increasing contribution of women to the rapid economic development occurring in many areas of East Asia has been accompanied by

a gradual "retreat from marriage," characterized in particular by late marriage and rising levels of singlehood (Jones 2007). All these current transformations run counter to many longstanding patriarchal institutions in which women's availability as wife and mother was at the core of the reproductive system and only the male line was responsible for the welfare of the elderly.

In South Korea the economic and social advancement of women has contributed to the rapid diminishing of bias by gender. A recent study by Chung and Das Gupta (2007) stresses the role of social change—encompassing both structural transformations and more importantly a gradual weakening of male-oriented social norms—in the SRB's rapid return to normal. The changing values of younger cohorts and further education of women are also seen as factors contributing to indifference to the sex of children born in Korea and Taiwan (Lin 2009). In South Korea, changes in the legal environment, starting in the 1980s, have been another significant factor. Several new gender-sensitive laws such as the Sexual Equality Employment Act of 1987 were introduced, and the patriarchal family law enacted in 1948 was revised in 1989.[35]

A different illustration of the decline in the SRB comes from a diffusion perspective. We have seen previously that couples with higher socioeconomic status initiated the decline in South Korea. In China, for which disaggregated SRB data are available, the sex ratio is lower among both the highest-educated segment of the population and the urban population. Continued socioeconomic progress may further reduce the SRB.[36]

The factors I have mentioned so far could be labeled structural or exogenous since they influence the gender system from the outside. But a different, internal factor is likely to contribute to lower sex ratios at birth in the future. High sex ratios at birth result in excess numbers of adult males after some two decades. Several studies have charted the magnitude and the impact of elevated ratios on the future age and sex composition of populations.[37] They indicate the extent to which such disequilibriums will be felt after two decades among young adults by creating a large surplus of men of marriageable age. The capacity of local family systems to cope with the growing shortage of young women remains unknown, but Asian marriage systems are unlikely to be flexible enough to allow all surplus men to marry.[38] With women likely to marry later or in slightly smaller proportions, the magnitude of the "bare branches" (as unmarried men are called in China) phenomenon is bound to disrupt traditional patriarchal arrangements.

In such a greatly altered demographic environment, having a son who may never marry would soon represent a serious social or economic hazard. It is ironic that the very precepts that underlay the initial demand for sons (and the parallel aversion to daughters) would deal a fatal blow to the patriarchal system. But this is typical of the kinds of endogenous response factors that account for the specificity of transition cycles. The most common illustration

in demography remains the feedback effect of falling mortality on fertility behavior, a mechanism lying at the core of the demographic transition.[39]

A tragedy of the commons in the making

In conclusion, I assess the implications of unbalanced sex ratios beyond the various benefits expected by parents of sons. Sex selection at birth is one of the clearest manifestations of gender discrimination, yet it remains inadequately studied in analyses of women's disadvantages.[40] As long as induced abortion is seen as a legitimate way to terminate unwanted pregnancies, sex selection appears more a reflection and consequence than a cause of intensified bias against women. The obvious demographic consequences of current discriminatory practices point to a different dimension of the collective cost of this male utopia: the growing deficit of women in Asia and the corresponding surplus of unmarriageable men.

Individual benefits and collective cost

The collective impact of unbalanced sex ratios encourages us to consider a balanced sex ratio as a public good, available to everyone, like clean air or world peace, as suggested by Miller (2001). The behavior of couples who want to avoid female births is typically an opportunistic strategy whose benefits seem clear in an environment in which boys are more valued than girls. But by tampering with normal biological outcomes, parents do not contribute their share of girls to the common demographic pool—a contribution necessary for the equilibrium of the marriage and family systems. Such behavior is typical of free riders; and, seen from a wider perspective, environmental economists will recognize the characteristic ingredients of a tragedy of the commons, the archetypical social trap in which free access to a public resource by individual interests leads to the depletion of the original shared resource (Hardin 1968). While a distorted sex ratio does not entail "irreversible" transformations (the way, for instance, deforestation and climate change do), more than a few male generations are potentially affected by the current sex ratio transition, and the aggregate loss in collective well-being is likely to be considerable.

The opportunistic behavior of individuals (in this instance the avoidance of female births) remains largely invisible to other members of society. For one thing, the monitoring of sex selection is difficult, except at the statistical level. Couples who seek to abort female fetuses are also those who have more girls on average; for this reason, they do not consider themselves guilty of gender bias. Moreover, the overall impact is not perceptible for some 20–25 years and will ultimately affect all families, including the majority who had boys without resorting to sex selection. These circumstances militate against the feasibility of institutional responses based on cooperative action such as

are often prescribed to reduce negative externalities in small communities (Ostrom 1990).

Promoting progress toward gender equity

We have seen that with parental bias for male births, two key factors prompting higher SRBs—low fertility and access to efficient sex selection—will probably contribute to a worsening situation in the years to come as the practice of sex selection spreads to new regions, ethnic groups, and social classes.[41] Greater gender equity and gender indifference appear to offer the main exit from this situation, with the marriage squeeze and social change as the two likely triggers.

The first trigger of change—demographic imbalances and male surplus—will have an unavoidable effect as perceived male scarcity is replaced by perceived overabundance. But the full effect will be postponed for several decades, a typical feature of a tragedy of the commons in which the legacy of today's actions is felt only by the next generation. The timing and pace of the second trigger in the decline in son preference—transformations of gender systems—are more difficult to anticipate. Traditional social systems may offer strong resistance to the assertion of women's autonomy and to the dilution of male social predominance. This is why the SRB may be expected to decline first among the higher strata of society and in metropolitan areas. South Korea's past experience and the traces of current SRB decline in urban areas in India and Azerbaijan corroborate this reasoning.

As is the case for externality problems that characterize environmental tragedies, action by governments and other third players may be essential to significantly alter the current gender equation and accelerate social change. For instance, laws prohibiting sex-selective abortions, which usually focus on the prohibition of prenatal sex determination, are being gradually reinforced or widened in various countries, starting with China and India.[42] Some of these measures, if properly enforced, will raise the overall "cost" of sex selection and delay or prevent its future diffusion across the population. To a large extent, the effectiveness of legal measures on sex-selective behavior remains uncertain, and emerging technology might render such measures powerless. Moreover, such restrictive policies run the risk of wrongly targeting legitimate abortion users or providers. The rapid and vigorous legal restrictions enacted in South Korea are, nevertheless, notable: not only was prenatal sex identification outlawed as early as 1987, but from 1990 onward doctors providing these services were threatened with heavy fines, suspension, and loss of license. As observed by Park and Cho (1995: 80), 1990 was the peak year before the SRB declined in South Korea. In 1995 the Korean Medical Association launched a media campaign against sex determination. A recent analysis of Korea's SRB decline, however, makes no mention of the legal mea-

sures taken against sex determination introduced earlier by the South Korean government, leaving open the question of the potential impact of restrictive legislation on discriminatory behavior in other Asian countries where it has been introduced and recently strengthened.[43]

Government intervention to increase gender equity can accelerate normative change in society. Governments can try to alter the gender equation with respect to son preference by extending support to girls and their families. Such policies of positive discrimination would contribute to leveling out the cost–benefit advantage of boys. Yet, policies based on subsidies are potentially expensive if they involve financial transfers and special benefits granted to families of girls. A government tax on the birth of a son would be highly unpopular in any country. Other measures by governments or NGOs in the field of advocacy entail information and awareness campaigns on gender issues. While probably slower to take effect, such campaigns can contribute to changing gender attitudes stemming from social transformations in Asia. Research on the effect of various policies on the SRB is in its infancy, and the effectiveness of legal restrictions on sex-selective abortion remains poorly documented.

Better statistical monitoring of excess male births through civil registration is another essential ingredient of efficient policy in those Asian countries where vital statistics have long been incomplete.[44] The fate of surplus male generations that have started accumulating in some subregions has already attracted extensive press coverage in India. The role of the media is considerable in spreading information about gender imbalances and their consequences, which include prolonged involuntary celibacy, atypical marriage migrations, and trafficking of women. One of the main recipes for resisting and reversing a tragedy of the commons lies in dispelling the "cloud of ignorance" (Hardin) and informing actors well in advance of adverse long-term consequences of their behavior. Demographers have played a key role in demonstrating the scale of the mounting sex ratios. Documentation gathered by journalists and social scientists on the situation of men facing a serious marriage squeeze will highlight the unsustainability of the current SRB regime and may accelerate changes in gender valuation and equity.

Conclusion

The first noticeable rise in the sex ratio at birth associated with prenatal screening of births in Asia dates back to the 1980s. It is now possible to identify some commonalities in this initially unanticipated trend. Sex selection can be analyzed by adapting the theoretical framework introduced by Coale for explaining the process of fertility decline. Change in SRB may be an integral part of fertility decline in some settings. The three necessary preconditions of this adverse development in gender discrimination were identified as (1)

entrenched traditional preference for sons in patriarchal societies ("readiness"); (2) access to modern sex selection ("ability"); and (3) the pressure caused by small family size ("squeeze"): in other words, the reasons why in a given context, parents want, can, and need to resort to active sex selection of their offspring.

It is tempting to devise a ranking of these three determinants of sex selection to assess their relative impact in the current rise in SRBs. But an in-depth analysis of these three factors is complicated by the lack of comparative data, especially on the relative access to sex-selection methods. The specific role of the supply factor also remains problematic. It could be argued—in a fashion similar to Pritchett's (1994) critical treatment of contraceptive access in explaining fertility decline—that the demand for sons is the decisive factor behind sex selection and that supply of sex-selection facilities merely represents the response to son preference in a given technological environment. However, modern sex selection relies on abortion and prenatal diagnosis, methods not available everywhere. It has been conjectured that fertility decline in regions such as the Middle East was in part hindered by poor access both to prenatal screening and to abortion by parents insisting on the birth of a son. [45] In such a setting, the unmet need for sex selection would encourage additional births (or recourse to cruder sex-selection methods), offering a case in which the potential interaction between different preconditions for sex selection complicates the overall picture. Another instance of interaction is the weakening of religious norms against abortion in the face of the heightened need to avoid unwanted births, a trend observed among many populations—from Azerbaijani Muslims to Buddhist Koreans—where fertility decline has been rapid. There are therefore persisting difficulties in adequately accounting for the separate influence on sex selection of the three factors I have singled out.

Statistical monitoring indicates that SRBs do not tend to increase to levels above 140 male births per 100 female births, and an incipient downturn appears discernible in several regions of Asia. According to the hypothesis of a sex ratio transition, SRBs would plateau at some threshold level and subsequently decrease as has happened in South Korea. This proposition accords with the larger perspective borrowed from resource economics in which resource overexploitation leads to behavioral readjustments. A sociological perspective provides additional explanations of why the sex ratio at birth would ultimately decrease to biologically normal levels under the influence of social and economic change as well as with government intervention to monitor and modify sex-selective behavior. Changes in family systems and in gender preference will probably be the main triggers of future normalization of SRBs.[46]

Nevertheless, prospects for a speedy reduction of now-elevated SRBs remain limited today, and South Korea's example will probably not be rep-

licated everywhere at the same pace. A rising SRB in several parts of Asia is a distinct possibility in the next decade. The pressure generated by further fertility reduction in South Asia in particular is likely to drive more couples to seek to abort unborn daughters. But in other areas, from Northwest India to Coastal China, where the SRB seems already to have reached its peak, signs of leveling off or decline are visible, and the stage may be set for the sex ratio transition to enter a second phase, characterized by a gradual reduction in prenatal sex selection in the coming decades. A weakening in the supply of sex-selection services, under the impact of direct intervention by public authorities through awareness campaigns and regulations, may also be envisaged. Action by government and civil society organizations will be a crucial element to facilitate the decline of the SRB and to alleviate the consequences of current imbalances. The laissez-faire attitude that has so far predominated, often prompted by entrenched Malthusian considerations from government authorities, has only added to the burden placed on future generations.

Appendix

Sources for sex ratio statistics used in the article, including Figure 1 and Table 1

International

Demographic and Health Surveys: reports from Armenia (2005), Azerbaijan (2006), Bangladesh (2004), India (2005–06), Nepal (2006), Pakistan (2006–07), Vietnam (2002).

United Nations, *Demographic Yearbook 2006*, 2008, Statistics Division, New York. http://unstats.un.org/unsd/demographic/products/dyb/dyb2006.htm

United Nations, *World Population Prospects, The 2006 Revision Population Database,* United Nations, Population Division, Department of Economic and Social Affairs, United Nations, New York, 2006.

World Health Organization, 2008, *World Health Statistics*: http://www.who.int/whosis/

National

Albania: *Femra dhe Meshkuj Në Shqipëri. Women and Men in Albania: 2006*, Institute of Statistics, Tirana, 2007.

Armenia: *The Demographic Handbook of Armenia*, 2007, National Statistical Service, Republic of Armenia, Yerevan. *Women and Men in Armenia*, 2008, Statistical Booklet, National Statistical Service, Republic of Armenia, Yerevan.

Azerbaijan: State Statistical Committee of the Republic of Azerbaijan: www.azstat.org/

China: *Tabulation of China 1% Population Sample Survey in 2005*, 2007, National Bureau of Statistics of China, Beijing, China Statistics Press [in Chinese].

Georgia: *Statistical Yearbook of Georgia: 2008*, 2008, Department of Statistics, Ministry of Economic Development of Georgia, Tbilisi.

India: *Sample Registration System Statistical Report,* Registrar General, Delhi, Controller of Publications, various years.

Montenegro: *Žene i muškarci u Crnoj Gori. Women and Men in Montenegro*, 2008, Statistical Office of Montenegro, Podgorica; *Sex and Age—Data by Settlements and Municipalities*, Census of Population, Households and Dwellings in 2003, Statistical Office. Podgorica [in Serbian].
Pakistan: *Pakistan Demographic Survey 2005*, 2007, Federal Bureau of Statistics, Ministry of Finance and Economic Affairs, Islamabad.
Singapore: *Yearbook of Statistics Singapore 2008*, 2008, Department of Statistics, Ministry of Trade and Industry, Singapore.
South Korea: Korean Statistical Information System: http://www.kosis.kr/
Taiwan: Department of Statistics, Ministry of the Interior, Taiwan: http://www.moi.gov.tw/stat/
Tajikistan: State Committee on Statistics of Tajikistan, Republic of Tajikistan, www.stat.tj.
Vietnam: *The 2007 Population Change and Family Planning Survey. Major Findings*. General Statistics Office, Statistical Publishing House, Hanoi 2008; unpublished data from the Survey of Birth in Health Facilities, 2007.

Regional

Delhi (India): *Annual Report on Registration of Births and Deaths*, 2007, Directorate of Economics and Statistics, and Office of Chief Registrar (Births and Deaths), Government of National Capital Territory of Delhi, Delhi.
Gujarat (India): *Annual Statistical Report on Registered Births and Deaths, Gujarat 2005*, State Bureau of Health Intelligence, Commissioner of Health, Medical Services, Medical Education and Research, Gandhinagar.
Haryana (India): Planning Department and Health Department, Government of Haryana, Chandigarh. http://www.indiastat.com/
Hong Kong: *Women and Men in Hong Kong 2008 Edition*, Census and Statistics Department, Hong Kong, 2008.
Rajasthan (India): *Annual Vital Report 2006*, Directorate of Economics and Statistics, Government of Rajasthan, Jaipur, 2008 [in Hindi].

Notes

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1 For a perspective on sex selection across Asia, see Gu and Roy (1995); Das Gupta (1999); Miller (2001); Croll (2000); Attané and Guilmoto (2007).

2 The sex ratio at birth typically oscillates around 105–106 male births per 100 female births. On the various determinants of SRB, see Teitelbaum (1972) and Waldren (1998).

3 Countries or regions for which the statistical database is too uncertain for a thorough examination of SRB trends include republics and oblasts of South Russia, Afghanistan, Bangladesh, Bhutan, Myanmar (Burma), Nepal, and North Korea. All statistical sources used in this article are listed in the Appendix.

4 Vital registration series in many countries are deficient or incomplete, or data may simply remain unpublished.

5 Tajikistan and Montenegro (Crna Gora) are two other cases of high SRBs not investigated here. The only suspicious SRB estimate available for Tajikistan is 113.5 in 1999, but no statistics have since then confirmed such a high level. High levels observed in Montenegro are also difficult to interpret in view of

the relatively small number of annual births, but the SRB computed for 65,432 births in the combined years 2000–07 is 109.8. The sex ratio of children below age 5 registered during the 2003 census was also high at 107.6.

6 South Korean data shown here are notoriously inadequate for the period preceding 1980. Moreover, the SRB in Korea has been affected during specific auspicious or inauspicious years (Lee and Paik 2006).

7 On the quality of Chinese birth data, including the 2005 survey estimates, see Goodkind (2008).

8 Estimates for SRB in Georgia are somewhat contradictory. The high values cited here are from the World Health Survey dataset, but the other SRB series with lower figures shown in Table 1 can be derived from Georgia's latest statistical yearbook, which provides the number of infant deaths and mortality rates by sex.

9 The three countries mentioned speak languages belonging to three language families (Indo-European, Turkic, and Caucasian) and use different alphabet systems. Membership in the Soviet Union for 70 years is their main commonality, which is in particular reflected in a fertility regime characterized by very high rates of induced abortion.

10 See also endnote 5 regarding Montenegro.

11 Several studies have identified the positive link between SRB and socioeconomic status in India (Bhat and Zavier 2007; Guilmoto 2008).

12 Results of research based on 1981–2004 births classified by parents' characteristics (Chun et al. 2009).

13 For an analysis of trends in census series, see Das Gupta et al. (2009).

14 For a comprehensive analysis of the slight SRB decline in China, see Goodkind (2008).

15 For a more detailed analysis of this leveling off and decline based on Indian SRB series, see Kulkarni (2007, 2008). Sources for regional data used in this analysis are given in the Appendix.

16 See the original paper by Coale (1973) and the later reformulation by Lesthaeghe and Vanderhoeft (2001).

17 Female infanticide and neglect of females are described in numerous studies from Bangladesh, China, and India that are summarized in Croll (2000). On infanticide, see Caldwell and Caldwell (2005) for a general perspective on Asia and Srinivasan (2006) on a small South Indian region.

18 The most appropriate approach to study this type of fertility limitation is to estimate differential stopping behavior according to the sex composition of previous children (Filmer et al. 2008). The sex ratio of the final birth, overly high when parents insist on a son, remains the simplest index to detect the presence of any sex-biased stopping rule.

19 First applied in 1959, the use of fetal sonography boomed in Western countries only in the late 1960s in the wake of technological improvements. Similarly, fetal sex determination through amniocentesis (amniotic fluid examination) was first performed in 1957, and the technique spread during the next decade. This section draws on material from Woo (no date), Croll (2000), Zeng et al. (1993), Miller (2001), Gupta (2000), and Ramanamma and Bambawale (1980).

20 Blood of the pregnant mother, containing fetal DNA from the embryo, can be tested after six weeks of gestation. Compared to other diagnostic methods, prenatal blood testing offers very early results with high levels of reliability. Controversy has been sparked by international companies that, since 2006, offer analysis of fetal DNA from blood samples to be collected at home and sent anonymously by mail. Some of them claim not to accept customers from India or China (Newiss 2006).

21 The first restrictive regulations forbidding prenatal sex determination were introduced in 1986 in China, in 1987 in South Korea (and repealed in 2008), and in 1988 in the State of Maharashtra and in 1994 throughout India. Regulations were later introduced in Nepal and Vietnam. Each country has its own provisions and law enforcement levels. See Tan (2008), Miller (2001), Croll (2000), and Gupta (2000).

22 The following overview is unavoidably based on "stylized" facts that may not always fit nicely with the diversity of kinship systems and gender arrangements across Asia. More precise descriptions of local contexts of

gender-based discrimination can be found in Sekher and Hatti (2007), John et al. (2008), Institute for Social Development Studies (2007), Chu (2001), Bossen (2007), Murphy (2003). For an overall perspective, see also Das Gupta et al. (2003) and Croll (2000).

23 Religious differentials in sex selection are discussed by Guilmoto (2008) for India and by Kim and Song (2007) for South Korea.

24 Female infanticide before the twentieth century was most notably reported in Northwest India and in East China (Caldwell and Caldwell 2005).

25 Another caveat concerns the social heterogeneity of gender preference. High-ranking communities (typically high castes in South Asia) and high-income groups (typically the landed peasantry and urban middle classes) will be especially responsive to aspects of gender bias related to rituals, prestige, and financial transactions. Lower-status or lower-income groups, such as unskilled workers in South Korea and China, low-status castes and tribes in India, and ethnic minorities in China and Vietnam, are therefore in a different position, and son preference is usually weaker among them. Similarly, groups following uxorilocal customs in rural China or intra-family marriages in South Asia will be less inclined toward discriminating against their daughters.

26 Estimates by Retherford et al. (2003) based on NFHS-2 data. See also state-level estimates derived from sample registration figures (Bhat 2002: 5257).

27 The squeeze effect described here corresponds to some extent to the so-called intensification factor (i.e., higher level of parity-specific discrimination) described by Das Gupta and Bhat (1997).

28 For instance, if sonless parents with an average fertility of 4 were to have only sons for the fifth birth, the overall SRB would rise only to 107.9. However, see the discussion below on infanticide and daughter aversion in high-fertility settings.

29 Second-child permits to parents of a girl were gradually introduced from the early 1980s onward in most of rural China. See Sharping (2003: 97–101) for details and Gu et al. (2007) on local fertility policies.

30 When annual SRB series are not available (such as for all-India and for China's provinces), I estimated threshold years by linear interpolation of available SRB measurements from various sources (census data for China and SRS estimates for India). National TFR estimates are from United Nations (2006), while regional estimates are from the Sample Registration System in India and from *Fertility Estimates for Provinces of China, (1975–2000)* for China.

31 The same exercise conducted using an SRB threshold of 115 demonstrates a similar heterogeneity in TFR levels, extending from values well below 2 in West and East Asia to values above 3 in many Indian states such as Haryana, Gujarat, and Bihar.

32 The potential role of the unavailability of prenatal diagnostic equipment in explaining the late rise in SRB in Vietnam is explored in Guilmoto et al. (2009).

33 As suggested previously, this framework may not apply perfectly to past demographic regimes characterized by the practice of female infanticide. In such historical settings, acute aversion to daughters, rather than mere preference for sons, was sufficient to overcome the weak fertility pressure and the absence of efficient sex-selection techniques.

34 An emblematic change of this type is the 2005 amendment to the Hindu Succession Act that made in particular all women—traditionally deprived of rights to joint-family property after marriage—coparceners in land property (Agarwal 2005).

35 Gender-related laws are summarized in Cho (2004) and analyzed in greater detail in various issues of *Women's Studies Forum* published by the Korean Women's Development Institute in Seoul. Earlier legislation was introduced more than 30 years ago when the political system was democratized.

36 The 2005 tabulations indicate that the SRB in China's cities (115.1) is lower than in towns and villages. Further processing of the raw data from the 2005 survey shows that the SRB among mothers with a college education is 112, a level significantly lower than that of less-educated women (work in progress conducted with Ren Qiang). Similar characteristics were observed in China's 2000 census.

37 Studies have focused on China's population (Attané 2006; Goodkind 2006). On China and India, see the effect of various SRB scenarios in Guilmoto (forthcoming).

38 The considerable size of birth cohorts in China and India ensures that demographic imbalances among young adults will be solved neither by plausible solutions like a regional redistribution, earlier female marriage, or more frequent female remarriage, nor by more far-fetched scenarios such as massive international marriage migrations or same-sex unions.

39 See for instance Reher and Sanz-Gimeno (2007). Another close analogy can be drawn with the "migration hump" described by Martin and Taylor (1996) or with the so-called Kuznets environmental curve (Dinda 2004).

40 A good deal of research focuses on gender-based inequality across or within countries and seeks to identify the ways in which gender disparities may manifest themselves. But failure to incorporate pre-birth discrimination as exemplified by prenatal sex selection leads to somewhat biased measurements that pertain only to surviving men and women. The recent *Gender Gap Report* (Hausmann et al. 2007) incorporates the SRB into its indicator of gender inequality.

41 The main exception to this rule is China, where fertility levels may increase in the case of a future relaxation of stringent family planning regulations (Zeng 2007). Goodkind (2008) examines the complex relationship between fertility policy and SRB in China.

42 The comprehensive approach adopted by Chinese authorities as part of the "care for girls" program includes various incentives and sensitization campaigns, but the government refrained from adopting more heavy-handed legislation (Li 2007; Tan 2008). On India's Pre-Conception and Pre-Natal Diagnostic Techniques (Prohibition of Sex Selection) Act, passed in 2003, see Josef (2007).

43 See Chung and Das Gupta (2007). On regulations governing abortion and sex selection in South Korea, see also Tedesco (1996), Westley (1995), Kim (2007).

44 The publication of census results in China and India played a major role in raising public and government awareness of the extent of rising SRB levels. Analysis of annual regional series as illustrated by the example of South Korea would, however, be far more effective for monitoring current trends and the impact of policy initiatives.

45 This hypothesis has recently been suggested by Courbage and Todd (2007: 79). Available data on both sex preference and differential stopping behavior demonstrate the preference for sons in countries such as Syria, Jordan, and Egypt (Williamson 1976; Cleland et al. 1983; Filmer et al. 2008; Yount et al. 2000). Sex differentials in mortality, however, may be on the decline in the Middle East (Yount 2001).

46 See for instance the work on the endogeneity of gender preferences by Leung and Zhang (2008). An attempt at modeling the relationship between SRB and fertility decline suggests that SRB may ultimately fall, given the assumption that "parents prefer a married daughter to an unmarried son" (Yoon 2006).

References

Abrevaya, Jason. 2009. "Are there missing girls in the United States? Evidence from birth data," *American Economic Journal: Applied Economics*, 1(2): 1–34.

Agarwal, Bina. 2005. "Landmark step to gender equality," *The Hindu*, 25 September.

Attané, Isabelle. 2006. "The demographic impact of a female deficit in China, 2000–2050," *Population and Development Review* 32(4): 755–770.

Attané, I. and C. Z. Guilmoto (eds.). 2007. *Watering the Neighbour's Garden: The Growing Female Deficit in Asia*. Paris: CICRED.

Bandyopadhyay, S. and A. J. Singh. 2007. "Sex selection through traditional drugs in rural north India," *Indian Journal of Community Medicine* 32(1): 122–134.

Banister, Judith and Kenneth Hill. 2004. "Mortality in China 1964–2000," *Population Studies* 58(1): 55–75.

Bélanger, D., Khuat Thi Hai Oanh, Liu Jianye, Le Thanh Thuy, and Pham Viet Thanh. 2003. "Are sex ratios increasing in Vietnam?," *Population* 58: 231–250.

Bhat, P. N. Mari. 2002. "On the trail of 'missing' Indian females: Illusion and reality," *Economic and Political Weekly* 37(51-52): 5105–5118, 5244–5263.

Bhat, P. N. Mari and A. J. Francis Zavier. 2007. "Factors influencing the use of prenatal diagnostic techniques and sex ratio at birth in India," in I. Attané and C. Z. Guilmoto (eds.), *Watering the Neighbour's Garden: The Growing Female Deficit in Asia*. Paris: CICRED, pp. 131–160.

Bossen, Laurel. 2007. "Missing girls, land and population controls in rural China," in I. Attané and C. Z. Guilmoto (eds.), *Watering the Neighbour's Garden: The Growing Female Deficit in Asia*. Paris: CICRED, pp. 207–228.

Caldwell Bruce K. and John C. Caldwell. 2005. "Family size control by infanticide in the great agrarian societies of Asia," *Journal of Comparative Family Studies* 36: 193–253.

Cho, Uhn. 2004. "Gender inequality and patriarchal order reexamined," *Korea Journal*, Spring: 22–41.

Chu, Junhong. 2001. "Prenatal sex determination and sex-selective abortion in rural central China," *Population and Development Review* 27(2): 259–281.

Chun, H., I. H. Kim, and Y. H. Khang. 2009. "Trends in sex ratio at birth according to parental social positions: Results from vital statistics birth, 1981–2004 in Korea" [in Korean], *Journal of Preventive Medical Public Health* 42(2): 143–150.

Chung, Woojin and Monica Das Gupta. 2007. "The decline of son preference in South Korea: The roles of development and public policy," *Population and Development Review* 33(4): 757–783.

Cleland, John G., Jane Verrall, and Martin Vaessen. 1983. *Preferences for the Sex of Children and Their Influence on Reproductive Behaviour*. Voorburg: World Fertility Survey, International Statistical Institute.

Coale, A. J. 1973. "The demographic transition reconsidered," in IUSSP (ed.), *Proceedings of the International Population Conference*. Liège: Ordina, pp. 53–73.

Courbage, Youssef, and Emmanuel Todd. 2007. *Le rendez-vous de civilisations*. Paris: La République des Idées-Seuil.

Croll, Elisabeth. 2000. *Endangered Daughters: Discrimination and Development in Asia*. New York: Routledge.

Das Gupta, Monica. 1999, "Gender bias in China, South Korea and India 1920–1990," *Development and Change* 30: 619–652.

Das Gupta, Monica and P. N. Mari Bhat. 1997. "Fertility decline and increased manifestation of sex bias in India," *Population Studies* 51(3): 307–315.

Das Gupta, Monica, Woojin Chung, and Li Shuzhuo. 2009. "Evidence for an incipient decline in numbers of missing girls in China and India," *Population and Development Review* 35(2): 401–416.

Das Gupta, Monica, Jiang Zhenghua, Li Bohua, Xie Zhenming, Woojin Chung, and Bae Hwa-Ok. 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): 153–187.

Dinda, Soumyananda. 2004. "Environmental Kuznets Curve Hypothesis: A survey," *Ecological Economics* 49: 431–455.

Douglas, A. and L. Edlund. 2008. "Son-biased sex ratios in the 2000 United States Census," *Proceedings of the National Academy of Sciences* 15: 5681–5682.

Fertility Estimates for Provinces of China (1975–2000). 2007. National Bureau of Statistics of China, Beijing, East West Center, Honolulu.

Filmer, Deon, Jed Arnold Friedman, and Norbert Schady. 2008. *Development, Modernization, and Son Preference in Fertility Decisions*. World Bank Policy Research Working Paper No. 4716.

Gammeltoft, Tine, Hanh Thi, and Thuy Nguyen. 2007. "The commodification of obstetric ultrasound scanning in Hanoi, Viet Nam," *Reproductive Health Matters* 15(29): 163–171.

Goodkind, Daniel M. 2006. "Marriage squeeze in China: Historical legacies, surprising findings," paper presented at the annual meeting of the Population Association of America, Los Angeles.

———. 2008. "Fertility, child underreporting, and sex ratios in China: A closer look at the new consensus," paper presented at the annual meeting of the Population Association of America, New Orleans.

Graham, Elspeth. 2007. "Son preference, female deficit and Singapore's fertility transition," in I. Attané and C. Z. Guilmoto (eds.), *Watering the Neighbour's Garden: The Growing Female Deficit in Asia*. Paris: CICRED, pp. 89–106.

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

Gu Baochang, Wang Feng, Guo Zhigang, and Zhang Erli. 2007. "China's local and national fertility policies at the end of the twentieth century," *Population and Development Review* 33(1): 129–147.

Gu Baochang and Krishna Roy. 1995. "Sex ratio at birth in China, with reference to other areas in East Asia: What we know," *Asia-Pacific Population Journal* 10(3): 17–42.

Guilmoto, C. Z. 2008, "Economic, social and spatial dimensions of India's excess child masculinity," *Population* 63(1): 93–122.

———. Forthcoming, "Skewed sex ratios at birth and long-term disruptions to demographic structures in China and India," *Asian Population Studies*.

Guilmoto, C. Z. and I. Attané. 2007. "The geography of deteriorating child sex ratio in China and India," in I. Attané and C. Z. Guilmoto (eds.), *Watering the Neighbour's Garden: The Growing Female Deficit in Asia*. Paris: CICRED, pp. 109–129.

Guilmoto, C. Z., X. Hoàng, and T. Ngo Van. 2009. "Recent increase of sex ratio at birth in Viet Nam," *PLoS ONE* 4(2): e4624.

Gupta, Jyotsna Agnihotri. 2000. *New Reproductive Technologies, Women's Health and Autonomy: Freedom or Dependency?* New Delhi: Sage.

Hardin, Garrett. 1968. "The tragedy of the commons," *Science* 162(3859): 1243–1248.

Hausmann, R., L. D. Tyson, and S. Zahidi. 2007. *The Global Gender Gap Report 2007*. Geneva: World Economic Forum.

Institute for Social Development Studies. 2007. *New "Common Sense": Family-Planning Policy and Sex Ratio in Viet Nam: Findings from a qualitative study in Bac Ninh, Ha Tay and Binh Dinh*, report for UNFPA, Hanoi.

John, Mary E., Ravinder Kaur, Rajni Palriwala, Saraswati Raju, and Alpana Sagar. 2008. *Planning Families, Planning Gender: The Adverse Child Sex Ratio in Selected Districts of Madhya Pradesh, Rajasthan, Himachal Pradesh, Haryana, and Punjab*. New Delhi: Action Aid and IDRC.

Jones, Gavin W. 2007. "Delayed marriage and very low fertility in Pacific Asia," *Population and Development Review* 33(3): 453–478.

Josef, Josantony. 2007. *Reflections on the Campaign against Sex Selection and Exploring Ways Forward*, study conducted by the Centre for Youth Development Activities commissioned by UNFPA, Pune.

Keown, Damien (ed.). 1999. *Buddhism and Abortion*. Honolulu: University of Hawai'i Press.

Kim Doo-Sub. 2008. "Recent rise and decline in sex ratio at birth in Korea: Revisited and revised," *Population and Society* 4(2): 59–89.

Kim Doo-Sub and Song Yoo-Jean. 2007. "Does religion matter? A study of regional variations in sex ratio at birth in Korea," in I. Attané and C. Z. Guilmoto (eds.), *Watering the Neighbour's Garden: The Growing Female Deficit in Asia*. Paris: CICRED, pp. 183–203.

Kulkarni, P. M. 2007. "Estimation of missing girls at birth and juvenile ages in India," paper commissioned by the United Nations Population Fund, India.

———. 2008. "Tracking India's sex ratio at birth: evidence of a turnaround," unpublished paper.

Lee, J. and M. Paik. 2006. "Sex preferences and fertility in South Korea during the Year of the Horse," *Demography* 43(2): 269–292.

Lesthaeghe, Ron and Camille Vanderhoeft. 2001. "Ready, willing, and able: A conceptualization of transition to new behavioral forms," in John B. Casterline (ed.), *Diffusion Processes and Fertility Transition: Selected Perspectives*. Washington, DC: The National Academies Press, pp. 240–264.

Leung, Michael C. M. and Junsen Zhang. 2008. "Gender preference, biased sex ratio, and parental investments in single-child households," *Review of Economics of the Household* 6: 91–110.

Li, Shuzhuo. 2007. "Imbalanced sex ratio at birth and comprehensive intervention in China," paper prepared for the 4th Asia Pacific Conference on Reproductive and Sexual Health and Rights, 29–31 October, Hyderabad, India «http://www.unfpa.org/gender/docs/studies/china.pdf».

Lin, Tin-chi. 2009. "The decline of son preference and the rise of gender indifference in Korea and Taiwan since 1990," paper for the IUSSP International Population Conference, Marrakech.

Martin, Philip L. and J. Edward Taylor. 1996. "The anatomy of a migration hump," in J. Edward Taylor (ed.), *Development Strategy, Employment, and Migration: Insights from Models*. Paris: OECD, pp. 43–62.

Meslé, France, Jacques Vallin, and Irina Badurashvili. 2007. "A sharp increase in sex ratio at birth in the Caucasus. Why? How?," in I. Attané and C. Z. Guilmoto (eds.), *Watering the Neighbour's Garden: The Growing Female Deficit in Asia*. Paris: CICRED, pp. 73–88.

Miller, Barbara D. 2001. "Female-selective abortion in Asia: Patterns, polices, and debates," *American Anthropologist* 103(4): 1083–1095.

Murphy, Rachel. 2003. "Fertility and distorted sex ratios in a rural Chinese county: Culture, state, and policy," *Population and Development Review* 29(4): 595–626.

Newiss, Hilary. 2006. "Regulating post-implantation fetal sex selection: A UK perspective," *Prenatal Diagnosis* 26(7): 627–630.

Nie, Jing-Bao. 2005. *Behind the Silence: Chinese Voices on Abortion*. Rowman & Littlefield.

Ostrom, Elinor. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press.

Park, Chai Bin and Nam-Hoon Cho. 1995. "Consequences of son preference in a low-fertility society: Imbalance of the sex ratio at birth in Korea," *Population and Development Review* 21(1): 59–84.

Pritchett, Lant H. 1994. "Desired fertility and the impact of population policies," *Population and Development Review* 20(1): 1–55.

Ramanamma, A. and U. Bambawale. 1980. "The mania for sons: An analysis of social values in South Asia," *Social Science and Medicine* 14B: 107–110.

Reher, David Sven and Alberto Sanz-Gimeno. 2007. "Rethinking historical reproductive change: Insights from longitudinal data for a Spanish town," *Population and Development Review* 33(4): 703–727.

Retherford, Robert D. and T. K. Roy. 2003. "Factors affecting sex-selective abortion in India and 17 major states," National Family Health Survey Subject Reports No. 21, International Institute for Population Sciences, Mumbai.

Sekher, T. V. and Neelambar Hatti. 2007. "Vulnerable daughters in a modernizing society: From 'son preference' to 'daughter discrimination' in rural South India," in I. Attané and C. Z. Guilmoto (eds.), *Watering the Neighbour's Garden: The Growing Female Deficit in Asia*. Paris: CICRED, pp. 295–323.

Sharping, Thomas. 2003. *Birth Control in China 1949–2000: Population Policy and Demographic Development*. London: Routledge Curzon.

Srinivasan, Sharada. 2006. *Daughter Elimination in Tamil Nadu, India: Development, Discrimination and Survival*. Maastricht: Shaker Publishing.

Tan, Liang Ying. 2008. "Changing mindsets: How China's abnormal sex ratio is turning its government into a champion of gender equality," *Asian Journal of Comparative Law* 3(1): Article 2.

Tedesco, Frank M. 1996. "Rites for the unborn dead: Abortion and Buddhism in contemporary Korea," *Korea Journal* 36(2): 61–74.

Teitelbaum, Michael S. 1972. "Factors associated with the sex ratio in human populations," in G. A. Harrison and A. J. Boyce (eds.), *The Structure of Human Populations*. Oxford: Clarendon Press, pp. 90–109.

United Nations. 2006. *World population Prospects: The 2006 Revision Population Database.* New York: United Nations, Population Division, Department of Economic and Social Affairs.

Varma, Roli. 2002. "Technological fix: Sex determination in India," *Bulletin of Science, Technology & Society* 22(1): 21–30.

Waldren, Ingrid. 1998. "Factors determining the sex ratio at birth," in United Nations, *Too Young to Die: Genes or Gender?* New York: United Nations, Population Division, Department of Economic and Social Affairs.

Westley, S. B. 1995. "Evidence mounts for sex-selective abortion in Asia," *Asia-Pacific Population Policy* 34(May-June): 1–4.

Williamson, Nancy E. 1976. *Sons or Daughters: A Cross-Cultural Survey of Parental Preferences.* Beverly Hills: Sage.

Woo, Joseph. No date. *Short History of the Developments of Ultrasound in Obstetrics and Gynaecology* «http://www.ob-ultrasound.net/history.html».

Yoon, Yong J. 2006. "Gender imbalance: The male/female sex ratio determination," *Journal of Bioeconomics* 8: 253–268.

Yount, Kathryn M. 2001. "Excess mortality of girls in the Middle East in the 1970s and 1980s: Patterns, correlates and gaps in research," *Population Studies* 55(3): 291–308.

Yount, Kathryn M., Ray Langsten, and Kenneth Hill. 2000. "The effect of gender preference on contraceptive use and fertility in rural Egypt," *Studies in Family Planning* 31(4): 290–300.

Zeng Yi. 2007. "Options for fertility policy transition in China," *Population and Development Review* 33(2): 215–246.

Zeng Yi, Tu Ping, Gu Baochang, Xu Yi, Li Bohua, and Li Yongping. 1993. "Causes and implications of the recent increase in the reported sex ratio at birth in China," *Population and Development Review* 19(2): 283–302.