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The sex ratio transition in Asia

Christophe Z. Guilmoto[*]

Abstract

The sex ratio transition in Asia

The paper adopts a comparative perspective to review the recent increase in sex ratio at birth across Asia. We first describe and compare the most recent birth statistics in Asia in order to identify commonalities in the gradual demographic masculinization observed from Armenia to South Korea. This comparison provides the basis for identifying the specific transitional patterns of current trends in birth masculinity. The recent rise in sex ratio at birth is then interpreted in a socio-historical framework borrowed from fertility decline and based on three preconditions: access to sex selection technology, gender preference, and pressure from low fertility. On a broader plane, the process of growing gender imbalances closely resembles that of a tragedy of the commons and this paper indicates the factors that appear most likely to trigger a turnaround in this transitional cycle and to facilitate a return to normal in the future.

Keywords: Asia, China, India, Gender, sex ratio at birth.

Résumé

La transition du sex ratio en Asie

Cet article adopte un point de vue comparatif pour examiner l'augmentation récente du sex ratio à la naissance en Asie. En premier lieu, nous décrivons et comparons les plus récentes statistiques sur la masculinité des naissances afin d'identifier les traits communs au processus de masculinisation démographique graduelle observé d'Arménie à la Corée du Sud. Cette comparaison permet de mettre en lumière le caractère transitionnel des tendances actuelles de la masculinité des naissances. Cet accroissement récent est ensuite interprété dans un cadre socio-historique emprunté à la baisse de la fécondité et fondé sur trois pré-conditions : l'accès aux technologies de sélection sexuelle, les préférences de genre et la pression exercée par la faible fécondité. D'un point de vue plus large, l'accroissement des déséquilibres sexuels ressemble étroitement à une tragédie des communs et l'article indique les facteurs qui ont le plus chance de provoquer un retournement de tendance et un retour à la normale dans le futur.

Mots clés : Asie, Chine, Inde, Genre, sex ratio à la naissance.

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The past decades have been characterized by a worldwide convergence thanks to the pace of demographic change in the developing world. Cases of regional specificities in demographic trajectories are seen as temporary traces of incomplete incorporation into the new social and economic order. And with Asia's population a prime illustration of this successful integration, it is all the more surprising to observe since the 1980s the rapid increase in the proportion of male births in the region, a trend representing one of the most notable anomalies in contemporary world demography.[1] Sex ratio at birth (SRB) [2] 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 or India with undetermined consequences. This process of demographic masculinization has proceeded at a pace unknown in recorded human history. Observers are still debating the exact causes, the future implications and the potential evolution of this phenomenon. Pessimists believe that the rise in SRB will continue unabated, especially as prenatal gender discrimination may spread to other Asian countries that have been left so far unaffected. Optimists and activists consider, on the contrary, that there are many ways in which the current trends may be reversed. But at this point, we may wonder if social scientists who have already observed many historical convolutions in population change –whether disease patterns or migration streams–do not have a feeling of *déjà vu* about what closely resembles yet another manifestation of an archetypal transitional cycle. This essay is an attempt to explore more systematically the implications of this notion.

We will adopt accordingly a deliberately comparative perspective to review trends and mechanisms of SRB increase across Asia by stressing commonalities rather than detailing the rich contextual circumstances in which gender-based discrimination mechanisms operate. This comparison provides the basis for a comprehensive framework to interpret the recent rise in birth masculinity, and for identifying specific transitional patterns in SRB trends.

Trends and variations in sex ratio at birth across Asia

While it is clear that over the last decades, sex ratio at birth has risen in several Asian regions above its normal level of 105, comparative data are not readily available. According to the estimates put forward by the Population Division of the United Nations for 1950-2005, the SRB lies in most countries within the usual 104-106 ranged. A few Asian nations are credited however with distinct SRB trajectories in which birth masculinity starts from a moderate value till the early 1980s, increases afterwards and peaks at levels between 110 and 120 till the 2010s, and declines back to more regular levels below 110 before 2050. With the exception of India where the SRB remains at 108 from 1990 onwards, all such trajectories are made up of a sudden rise occurring after 1990, followed by a plateau level for a decade and a gradual decrease afterwards. According to these estimates, all affected Asian countries are presently in their highest ever level of sex ratio at birth.

To complement these rough estimates, we have compiled in Table 1 sex ratio statistics for countries in which the presence of inordinate SRB levels can be established[3]. Figures drawn from a variety of

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

[2] Sex ratio at birth typically oscillates around 105-106 male births per 100 female births. On the various determinants of SRB, see the detailed presentation by 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 paper are listed in the Appendix.

sources refer mostly to the last five years. Three different types of sources are brought together here: birth registration –by far the most appropriate source when available[4]–, birth history estimates from large surveys, and census data on recent births or age structures. While the best indicator remains the SRB itself, we have also introduced the child sex ratio –an indicator also influenced by mortality differentials– when SRB data are old or unreliable.

Asian countries affected belong to three regional blocks: East Asia (China, Taiwan, Singapore, and Viet Nam), South Asia (Pakistan, India) and West Asia (Armenia, Azerbaijan, and Georgia), to which we added Albania, the only non-Asian country in which a recent SRB increase could be ascertained[5]. We have not included the neighbouring countries where the sex ratio at birth has remained so far normal: Turkey, Iran, Sri Lanka, Japan, Thailand, Malaysia, Philippines, or Indonesia. Whenever relevant and feasible, we produce regional estimates for selected Indian States or Chinese provinces.

We will also examine annual SRB series for three countries with reliable civil registration statistics. Countries retained here are Azerbaijan and South Korea, to which we added China with a probably less reliable series[6]. These data (annual estimates and three-year moving averages) for 1975-2007 are brought together in Figure 1.

East Asia

Annual series indicate that the SRB rise in South Korea and China started almost simultaneously and ran parallel during the first ten years. Dating exactly the onset of this increase is a difficult exercise in view of past fluctuations in SRB levels, but 1980 can be taken as a turning point. The rise may have been initiated earlier in specific subpopulations as may suggest the case of Singapore where the SRB among Chinese fathers rose during the 1970s (Graham, 2007). The 115 threshold was reached first by South Korea in 1990 followed by China in 1994. But the most important difference lies in the stalling of the SRB in South Korea at a plateau of 114 in the early 1990s, followed by a gradual reduction afterwards. This downward trend has continued till today and the latest South Korean SRB figure of 106 in 2007 is almost normal. Comparing the annual rate of change in SRB during both the upward and downward phases in South Korea, we observe that the subsequent decline appears to be somewhat slower at -0.6 SRB point per year after 1994 than the initial rise of 0.8 per year during the 1980s.

The sex ratio at birth continued to grow in China well over the 115 mark during the 1990s to attain 120 in 2000. The most recent figure based on births during the year prior to the 2005 sample census suggests a virtual SRB stagnation at 120.5. Chinese SRB data are however regarded as fragile in view of the risks of birth underenumeration as well as the discrepancies found in published tabulations. In spite of the many confirmations of the declining proportion of female births, available estimates

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

[5] Tajikistan and Montenegro (Crna Gora) are two other cases of inordinate SRB not investigated here. The only suspicious SRB estimate available for Tajikistan is of 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 small number of annual births, but the SRB computed over 65,432 births in 2000-07 is 109.8. The sex ratio of children below 5 registered during the 2003 census was also high at 107.6 boys per 100 girls.

[6] Other affected areas with adequate annual series include Armenia, Singapore or Taiwan. Korean data shown here are however notoriously inadequate for the period preceding 1980. Moreover, the SRB in this country has also been affected during specific auspicious or inauspicious years (Lee and Paik, 2006).

drawn from a limited number of sources may not capture faithfully the true absolute SRB level in Chinese provinces and should rather be used as indicators of relative variation[7].

When broken down at the regional level, Chinese data reflect a more complex picture as SRB levels are extremely high in several provinces such as Jiangxi or Anhui while levels are lower in Western provinces or metropolises such as Beijing, Tianjin or Xinjiang. We may also in this connection highlight the trends in more developed Hong Kong, Taiwan as well as in Singapore, where in spite of a detectable increase, the SRB has hardly risen above 110[8].

Elsewhere in East and Southeast Asia, SRB levels have remained stable as can be attested by detailed statistics from Japan, Thailand or Indonesia. The only exception is Viet Nam. The country has long been suspected to practice gender discrimination, but surprisingly, no rise in this country was perceptible till the beginning of the century. The sex ratio at birth is, however, now on the rise and has reached 111 in 2006, with slightly higher figures observed in the prosperous rural delta region to the North of the country (Bélanger *et al.,* 2003; Guilmoto *et al,.* 2009).

South Asia

For lack of adequate civil registration data, the rise in SRB cannot be annually monitored as done for other countries. It is chiefly child sex ratio figures derived from the 1991 census that highlighted the rise that took place during the 1980s, even if qualitative studies had already offered clear evidence on the successful introduction of sex selective abortions in the country.

Another obscuring factor is the regionally confined nature of prenatal discrimination in India, which results in a moderate national SRB average around 113 (Kulkarni, 2007). In affected regions, mostly located in Northwest India, the sex ratio did however rise continuously at a pace similar to China's and reached values above 120 at the turn of the century. The SRB started also to rise later in some other regional pockets of the country away from the Northwest. Again, like in China's most affected provinces, many smaller areas within Punjab or Haryana have registered somewhat dramatic sex ratio figures in the 130-150 range. At the same time, sex ratio levels has shown no sign of abnormal increase in many Indian states, from more developed areas to the South to impoverished regions in central India.

Evidence of increasing birth masculinity in other South Asian countries has remained scarce, despite well established postnatal discrimination against girls in many areas. It is only very recently that the two latest demographic surveys in Pakistan have indicated inordinate sex ratio at birth, but the lack of other census and registration data precludes a more detailed regional analysis. While Sri Lanka is like most of South India devoid of sex selection, Bangladesh and Nepal might join soon the list of affected countries.

West Asia

Moving now to West Asia, the Caucasus offers an interesting case as the proportion of male births did not rise substantially before the 1990s. Historical series from Azerbaijan indicate that the SRB had only slightly increased from 104 to 106 from 1965 to the late 1980s. The surge in this country dates from 1992, the year following the country's declaration of independence from Soviet Union. The pace of

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

[8] Singapore, with its majority Chinese population, provides another case of moderate increase as SRB has always remained below 110.

increase of 0.9 SRB point per year was exceptionally fast, but was interrupted in 2002 at a level of 117. While this development may appear somewhat atypical at first sight, it is in fact part of a well-established pattern of rapidly increasing SRB levels in all newly independent countries of the South Caucasus. It ran exactly parallel to the rise in SRB observed in Georgia and Armenia after independence. In Georgia, where the rise proved the fastest, the sex ratio at birth reached 119 in 1998[9]. Available series from Armenia tell the same story as the sex ratio of the population below one has reached a maximum value at 116 during the 2001 census and oscillates since then. When available, estimates from the Demographic and Health Surveys provide an independent confirmation of this inordinate SRB levels.

Incidentally, the South Caucasus is linguistically and culturally an extremely diverse region and should not be seen a perfectly homogeneous entity[10]. But the end of the Soviet rule in these three countries, accompanied by significant fertility decline, seems to have set in motion the same demographic manifestation of gender discrimination, characterized in particular by especially high SRB among third births (Meslé *et al.*, 2007). Comparison with other former Soviet republics indicate that almost no country from Eastern Europe to Central Asia appears to have been affected by a sizeable increase in SRB and that slightly suspicious SRB levels are only found in the Caucasian part of the Russian Federation bordering Georgia and Azerbaijan. The only exception is Albania where the SRB has also distinctly risen during the 1990s with levels above 113 recorded after 2000[11].

A sex ratio transition

Before reviewing, in the next section, the different factors behind the processes of demographic masculinization, the preliminary comparative exercise allows us to outline the stylized patterns of SRB change. To a large extent, the recent rise in SRB observed across Asia resembles a diffusion wave similar to that of fertility decline or epidemics. In such a framework, sex determination technology (ultrasonography and amniocentesis) can be considered the key innovation that allowed couples to resort to sex selection in a context otherwise characterized by declining fertility and entrenched son preference. Selective abortions were first adopted by "pioneer groups" as a solution to the fertility predicament common in Asia: reducing the number of children while maximizing the probability to beget at least one son. As in many cases of innovation propagation, forerunners were initially preponderantly urban, well-to-do and better educated. Whenever available, decomposition of the rise in SRB illustrates the forerunning role played by urban elites which were the first to get adequate information and access to the new sex selection technology[12]. But the fast rising sex ratio at birth observed after a few years followed the diffusion of this new sex selection strategy to new groups or to neighbouring regions. This was in particular made possible by the spread of information, widening supply mostly through private health care facilities and the declining cost of the ultrasound

[9] Estimates for SRB in Georgia are somewhat conflicting. The high values quoted here are from the World Health Survey dataset, but the other SRB series with lower figures used in Table 1 can be derived from the latest Georgian statistical yearbook, which provides infant mortality deaths and rates by sex.

[10] The three countries mentioned do not share common religious and cultural traditions. They speak languages belonging to three distant language families (Indo-European, Turkic and Caucasian) and use different alphabet systems. Membership to the Soviet Union for seventy years is their main commonality, which is in particular reflected in a fertility regime characterized by very high frequency of abortion.

[11] See also footnote 6 about the situation in Montenegro.

[12] Several studies have identified the positive link between SRB and socioeconomic status in India (Bhat and Zavier, 2007; Guilmoto, 2008). This association appears more ambiguous in Chinese counties (Cai and Lavely, 2004).

machinery. Regional maps demonstrate for instance the gradual propagation of high sex ratios across affected countries (Guilmoto and Attané, 2007; Kim and Song, 2007).

The first phase of this transition is far from exhausted. As a matter of fact, there are several countries and regions in Asia at risk of SRB aggravation in the future. Viet Nam's case has been already mentioned, but India's neighbours –Pakistan, Nepal and Bangladesh- offer other examples of areas with high SRB potential. In Western China, and in Central or Eastern India, large areas that have remained so far little affected may also fall prey to increasing sex selection.

There are at the same time signs indicating that the SRB is unlikely to rise endlessly and that the process of demographic masculinization may be reversible. The sex ratio at birth appears to level off in several settings and may ultimately normalize after a prolonged period. Such a transitional pattern is illustrated by South Korea, where it is possible to monitor annual variations since 1980. The rise in SRB to unprecedented levels above 115 around 1990 was reversed during the mid-1990s and followed by a regular decline. The latest SRB value (106 in 2007) suggests that the whole SRB cycle is almost over. It may be further noticed that the SRB went beyond 120 in Taegu city or in Kyongbuk and Kyongnam provinces, whereas other regions in the south-western side of the Korean peninsula were far less affected by the overall surge in masculinity. These regional differentials have been related in part to the population's religious composition, but there is a distinct spatial patterning as well (Kim and Song, 2007). Additional data on sex ratio downturn in South Korea illustrate the diffusional nature of this transitional process: the sex ratio rise started among more advanced strata of the society –tertiary workers and the college-educated– a few years earlier than among the rest of the population. The inception of the transition dates back probably to the late 1970s among these pioneer groups, but the SRB also plateaued out earlier and at a lower level, and started to decline before 1990. In comparison, the transition among manual workers or the less educated took place later, culminated at a higher level, and started to diminish only in 1995[13]. From that somewhat unique example, we can observe the distinct trajectories of various social groups corresponding to different phases of the sex ratio cycle.

Turning now our attention to other Asian countries, we can discern other signs of stalling or of downward trends in birth masculinity[14]. In China, the SRB did decline appreciably in 2000-05 in several regions such as in the contiguous provinces of Guangdong, Hainan and Guangxi in the Southeast part of the country. In some other areas, the sex ratio at birth is simply stagnating. Once disaggregated, regional data point to distinct regional trajectories contrasting core areas of East China with interior regions where birth masculinity took off later. In addition, it may be noticed that SRB levels have been stagnating in Taiwan over the last few years and have almost returned to normal in Singapore[15].

Current downward trends are however not restricted to China or South Korea. In India, where the SRB had increased most rapidly in Punjab, it seems to have reached a maximum level of 133 at the turn of the century, after which a slight decrease is visible from available data. Similarly, in a State like Delhi for which birth registration data are available over a longer period, the SRB has continuously increased in the 1990s till 2001 when it reached the record value of 124. Since then, birth masculinity has slightly diminished and was estimated at 118 in 2007. In a few other affected regions such as Gujarat, Rajasthan and Haryana, figures from civil registration and from the Sample Registration

[13] Preliminary results of a research based on the 1982-2004 births classified by parents' characteristics by H. Chun, I-H Kim and Y-H Khang (Chun Heeran, personal communication).

[14] For an analysis of trends on census series, see Das Gupta *et al.* (2009).

[15] For a more comprehensive analysis of the slight SRB decline in China, see Goodkind (2008).

System (SRS) point also to a slow SRB decline as in Gujarat, Rajasthan and Haryana. Interestingly, the turnaround appears to have been mostly confined in urban areas where SRB is usually higher in the countryside. SRB levels have for instance declined respectively by 8 and 13 per 1000 in Punjab and Haryana during 2000-2005 according to the SRS series[16].

Since the turn of the century, birth masculinity is also apparently stagnating or declining in the three Caucasian countries. Differences within Azerbaijan are also visible. The rise in SRB took place faster in urban areas (dominated by the capital city of Baku) than in the countryside and there is a time lag of about 4 years between urban and rural SRB levels. But according to the latest civil registration figures, the SRB in Azerbaijani towns is gradually decreasing today, down from 120 in 2003 to 116 in 2006.

This review of SRB trends shows therefore that we can observe many instances of stagnation or downward trends since 2000, suggesting that once a certain level is reached, SRB figures may level off and then decline. This resembles the typical patterns of a transitional phenomenon. During its first phase, the SRB increases following classical diffusion mechanisms originating mostly from high-density urban areas or from prosperous, more educated strata of society. A fully transitional model as illustrated by South Korea's bell-shaped masculinity trends would further imply the ultimately reversible character of the process with SRB's gradual return to normal during a second phase.

Viewed in this way, the sex ratio transition remains however a conjecture based on partial trend patterns of SRB trajectories that should only serve as an initial heuristic exploration. If we want to go beyond a purely "chartist" interpretation, we need, however, to better understand the structural or endogenous factors of change that may account for this SRB turnaround. To flesh out the possibility of a sex ratio transition beyond the surface of demographic trends, it is therefore imperative to investigate now in more detail the social and economic conditions across Asia that gave birth to the rising masculinity of births in the first place.

Mechanisms and underlying causes

In part because of the deficient data available to researchers, the respective role of various potential determinants of observed gender imbalances –voluntary or involuntary under-registration, biological differences, abortions, mortality differentials, female infanticide– have long blurred the understanding of the rising proportions of boys among children. The prominent role of sex-selective abortions in the process has been only slowly acknowledged. But the recognition of the proximate cause for rising sex ratio still leaves unanswered the question of the common elements accounting for the almost simultaneous demographic masculinization observed in several Asian countries.

We should observe at the outset that contemporary sex selection is neither considered socially aberrant nor a legacy of an archaic mindset. From the actors' points of view, contemporary discrimination against unborn girls emerges as a rational strategy coming as a response to changing constraints and opportunities within existing gender regimes. To summarize the causal processes at work, we may start from the classic RAW framework introduced by Ansley Coale for explaining fertility decline in Europe[17]. 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

[16] For a similar interpretation of this stagnation and near decline based on Indian SRB series, see Sharma and Haub (2008). See also Kulkarni (2007) for SRB estimation in India. Sources for regional data used in this analysis are given in the appendix.

[17] On the RAW framework, see the original paper by Coale (1973) and the later reformulation by Lesthaeghe and Vanderhoeft (2001).

it; and the methods to achieve it have to be available to them. We will adapt now these prerequisites to the sex-selection situation by saying that sex selection should be first feasible since parents need access to efficient methods to alter the random, biological distribution of children by sex. It should also be "conceivable" by parents and the objectives and the methods to this end socially acceptable. And it should finally be perceived as socially or economically advantageous.

In other words, parents have to be able (1st condition), willing (2nd condition) and ready (3rd condition) 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 or legal environment that affect the ability of people to manipulate the sex composition of their offspring. The next two preconditions, as originally proposed by Coale, can easily be merged into a single one: are people willing and ready to practice sex selection? First of all, there are social conditions related, for instance, to the ethical or religious context allowing parents to engage in sex selection. Some of its ingredients (especially 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, as it is in most developed countries, it does not lead to a specific outcome for want of entrenched gender preference.

These two conditions of readiness and ability correspond to the supply and demand framework extended to prevailing social norms. But as we will see, we need to add a third squeeze factor typical of low fertility situations in which deliberate sex selection substitutes for additional childbirths as the easiest solution to the gender requirement. We will now examine the nature of these three preconditions to 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 changing ability of families in Asia to influence the gender composition of their offspring has indeed proved for the last three decades to be one of the main drives behind the rise in birth masculinity. But if access to sex selective abortions is today the main proximate variable of sex discrimination, it should be emphasized that many traditional methods that aimed at favouring the birth of sons did exist in the past.

Traditional methods

There is a wide range of age-old methods to influence the sex composition of a family's children (Institute for Social Development Studies, 2007; Bandyopadhyay and Singh, 2007). Some are based on the belief that physical circumstances or divine intervention would ensure the "right" sex and these are still often reported today. 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. But there are many other ways thought to be able to influence the sex of the child as well, including prayers, the timing and type of intercourse, meteorological or astronomical circumstances, etc. Among Hindus, codified *pumsavana* rituals are for instance performed during the second trimester of pregnancy to beget sons. But even if pointing to clearly defined gender preferences, these prenatal "folk methods" were of limited reliability, and thus unlikely to have left any tangible trace on the demographic sex composition.

There are other remnants of the "old discriminatory regime", however, that have not disappeared, in spite of the emergence of modern prenatal selection[18]. One of the oldest methods to alter the gender composition of children is also the crudest, *i.e.*, female infanticide. It has long been reported in Asia, and it has not yet entirely vanished from some countries. Girls may be killed within a few days after their birth, and techniques vary locally according to indigenous know-how and available local resources (such as poisonous plants). Infanticide's effectiveness is beyond doubt, and its financial cost is also extremely limited. Under a milder form, female abandonment is another solution to get rid of unwanted daughters, but abandonment and adoption are on the whole less common in Asia than elsewhere. But the practise also presents many drawbacks, especially due to the distress caused to mothers, and as a result, infanticide as a routine practice has often been limited to some regions or local communities. Poverty reduction and the enforcement of criminal laws represent further factors behind the reduction of infanticide in contemporary Asia.

Neglect of the girl child is a far more common method. It corresponds to a rather passive strategy intended to deprive girls of their fair access to and share of household resources. This bias results in excess mortality among girls that are still pronounced in China and Northwest India and directly impact juvenile sex ratio levels. In fact, according to the United Nations Population Division, female mortality below 5 in 2000-05 is above male mortality only in a few countries in the world, among which we find Nepal, Pakistan and India. China, however, stands apart with a record excess female mortality estimated at 42% above male mortality (see also Banister and Hill, 2004). Factors related to excess female mortality include post-natal care, proper clothing, parental surveillance, breastfeeding, food allocation, recourse to health facilities, immunization, etc. But it is important to stress that discriminatory behaviours against girls do not invariably cause mortality and many Asian girls survive childhood in spite of such discrimination. Neglect can therefore be seen as a "low-tech method": while it requires almost no financial or other effort from parents, its effectiveness as a way to change the sex composition of the offspring is limited.

Differential contraception and high-tech methods

One of the oldest methods to adjust one's fertility to gender requirements consists in avoiding further births once the ideal family composition attained. The introduction of family planning methods in many Asian countries from the 1960s onwards has enabled parents to practice this method in a more efficient manner by giving them adequate methods to stop childbearing: this corresponds to what has often been described as the "stopping rule", whereby parents (usually of sons) are shown to avoid births in greater proportions than sonless parents[19]. While undoubtedly more effective to prevent unwanted births than previous birth control methods, this strategy however assumes that sonless women be prepared to undergo additional pregnancies to give birth to a son. As we will see further below, this strategy is at odds with fertility decline or official fertility regulations.

[18] Female infanticide and female neglect are described in numerous individual 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.

[19] The formally most appropriate approach to study this type of fertility limitation consists in estimating differential stopping behaviour according to gender composition of previous children (Filmer *et al.,* 2008). The sex ratio of the final birth, overly masculine when parents insist on a male progeny, remains the simplest index to detect the presence of any gender-biased stopping rule.

Today's sex selection relies on the combination of two prenatal diagnostic techniques that appeared in the 1970s –amniocentesis and ultrasonography– with abortion[20]. It is difficult to trace the precise date of their mass introduction in Asia, but scientific research in China related to ultrasonography was already 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 set up in family planning stations and clinics during the next decade. The trial introduction of amniocentesis in India in the mid-1970s immediately led to women aborting unwanted female foetuses. Ultrasound was introduced a few years later. By the 1980s, hundreds of clinics offering amniocentesis or ultrasound services were already in operation in these countries to cater to the needs of parents anxious to know the sex of their child and likely to abort thereafter female foetuses. In many countries such as Viet Nam, modern ultrasonography appears to have been introduced later.

There are nowadays more "high-tech" sex selection techniques such as pre-implantation methods and foetal blood testing[21]. But these techniques are expensive and require access to a well-equipped laboratory. They are for a variety of reasons, including cost and legal prohibition, not yet readily available to Asian residents.

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

The technological breakthrough over the last three decades has brought about a rapid transition from traditional postnatal sex selection to modern prenatal techniques, which undoubtedly represents a historical revolution in the age-old discriminatory systems in Asia. In comparison, old methods employed so far to eliminate children of the undesired gender were inefficient or traumatic[22]. Infanticide, abandonment, neglect, traditional preconception methods of sex selection and stopping rules implied that women undergo repeated pregnancies and deliveries to no purpose. In comparison, advantages of the modern sex selection are many: women are spared the entire duration of pregnancy, selection acts are performed under medical control and are relatively safe as long as the abortion is performed by trained practitioners. Sex selective abortions look invariably more "modern" and "rational", as well (Varma 2002; see also Gammeltoft *et al.*, 2007): not only is it part of modern health

[20] 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, but the technique spread during the next decade. This section uses materials from Woo (no date); Croll (2000); Zeng *et al.* (1993); Miller (2001); Gupta (2000); Ramanamma and Bambawale (1980).

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

[22] Infanticide is for instance described in a study as "not cost-effective" (Zeng *et al.* 1993: 295).

care provision, but it also reflects the capacity of women to anticipate the consequences of a female birth from the beginning of pregnancy. The effectiveness of the method is almost 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 with relatives, such as the husband or his family.

Technological diffusion and control

The availability of sex-selection methods is first mediated by knowledge and awareness of their existence. Traditional methods had long been in place, and were therefore well known in given communities, with even 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 thirty years ago, and require specific infrastructures. For instance, the recent rise of SRB in Viet Nam is closely linked to the late boom for scanning facilities introduced in private clinics and hospitals (Gammeltoft *et al.*, 2007). It is also probable that only very few health structures in countries like Myanmar, North Korea or Afghanistan offer quality ultrasound facilities.

The new sex selection strategy spread however fast in several Asian countries through different channels, ranging from interpersonal exchanges among users to aggressive publicity by suppliers. Because of the proximity of both ingredients of sex-selective abortions –sex identification and pregnancy termination– to family planning and reproductive-health efforts, these two procedures benefited separately from wide publicity, either as a component of modern pre-natal 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 units such as private clinics or local public dispensaries, contributed to their wide diffusion across urban and then rural localities of Asia. In many countries, a boom in private health care and the growing purchasing power of the new expanding middle classes was decisive in the spread of the new technology.

Legislation is however becoming a central part of the supply framework in several countries. We have already mentioned its role when describing the various legislations related to abortion in Asia, ranging from strict prohibition to extremely liberal policies. But an additional factor relates to the introduction of laws to check sex-selective abortion of foetuses. Regulations were indeed introduced early on in South Korea, China and India, albeit incompletely enforced[23]. Stricter implementation of existing laws and new legislation represent nowadays a significant transformation in the supply-side part of our overview as we will examine further below.

The Need for Sons

Understanding the rationale behind sex preference is no doubt the key to deciphering the dynamics of sex ratio in Asia and what Miller calls "patriarchal demographics" (2001: 1086). This is probably a better-known territory as the literature on gender preference and discrimination has increased in the

[23] The first restrictive regulations forbidding prenatal sex determination were introduced in 1986 in China, in 1987 in South Korea (and repelled in 2008), and in 1988 in the State of Maharashtra and in 1994 in whole of India. They were later on introduced in Nepal and Viet Nam. The legal setup is however more intricate in each country, with various provisions and law enforcement levels. See Tan (2008); Miller (2001); Croll (2000) and Gupta (2000).

last decades. In this section, we will sum up what makes sex selection socially acceptable and why the birth of a son should be perceived as being more "rewarding" than that of a girl.[24].

The social acceptability of sex selection

Sex selection needs first to be considered acceptable. There are no philosophical or religious principles that 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 in most parts of Asia. Similarly, abortion still remains a very sensitive matter for many mothers, including in countries like China where it is widely prevalent (Nie, 2005). In some specific religious communities –such as among Christians or Muslims– abortion is discouraged or condemned, and sex ratios are closer to normal levels among these groups, thereby accounting for perceptible differences within countries like South Korea or India[25]. But religiously sanctioned rules are often ignored as illustrates the prevalence of abortion in countries such as Korea or Japan where strict traditional Buddhist norms should prohibit it (Keown, 1999).

The social and economic rationale

The most common explanation of gender discrimination is usually economic and boils down to the fact that girls are therefore not as "cost-efficient" as boys. To start with, raising a girl is often held as a source of additional expenses related to specific protective efforts extended only to daughters. In South Asian countries, for instance, girls are perceived to be especially vulnerable, as family honour rests to a large part on women's behaviour rather than on men's. It is with reference to costs arising during or after their marriage that daughters appear to be especially "expensive" compared to sons. In South Asia, costs incurred during the wedding and the institution of dowry make marriage expenditures extremely asymmetrical because of the dowry paid in kind or in cash by the bride's family to the groom's, which often includes also post-marriage transfers. High dowry will ensure a proper marriage into the best possible family –hypergamy being a tacit norm– and bestows additional prestige and reputation to the bride's family. Dowry arrangements, long common among higher status groups, have now spread to almost all segments of society in South Asia. Yet, the picture in other countries, such as in East Asia, is more balanced. Not only are dowry amounts less sizeable, but the reverse practice of bridewealth is also very common in many settings such as rural China.

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

[24] 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 female discrimination can be found in Sekher *et al.* (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).

[25] Religious differentials in sex selection are analyzed by Guilmoto (2008) for India, and by Kim and Song (2007) for South Korea.

ageing parents. Sons are rewarded by inheritance rules that are almost systematically biased in their favour.

The advantage of sons extends to non-financial domains, such as their being a source of protection and affection for the parents. Having several sons in rural China is also preferable as a way to strengthen the family power within the clan or vis-à-vis rival clans. But there are many more symbolic advantages in having sons, such as preservation of the family and the clan, or the role of sons in rituals to the ancestors or during funerals, tasks from which women are customarily excluded in Asia. Daughters are expected to live away from their parents and to have limited interaction with them after marriage. As such, it seems that, socially and economically speaking, having sons is a much more sound option than raising daughters ("watering the garden of your neighbour"). Each cultural setting is replete with customs and sayings celebrating the birth of sons and lamenting that of daughters.

This section has summarized the gender factor as "preference for sons". The independent role played by a specific aversion for daughters (rather than son preference) should however be noted. In contexts where the birth of a girl adds to the burden of the community or of the family, discrimination against girls may be more related to status or economic reasons (such as hypergamy, dowry costs etc.) than to a distinct desire for sons. This is in particular the case of many Asian settings in which many girls were in the past either killed or abandoned after birth. In these areas, fertility was however relatively high and sex selection technology primitive.[26] But sorting out the respective weight of broader gender preference towards boys and more specific aversion for girls remains often difficult.

Many dimensions covered in this section relate to status symbols and to purely economic advantages. A word of caution is required, however, when applying a narrowly utilitarian cost-benefit analysis to gender valuation since the rules of the economic game are only partly economic. The distortions caused by inherited social institutions –which are at the root of the patriarchal set-up– severely alter the pure rational-choice framework favoured by economists in their analysis. Many cultural constraints typical of local gender arrangements –such as virilocality, dowry or discriminatory inheritance rules– have limited economic rationale. The "readiness" precondition should therefore be seen as a complex blend of age-old traditions and gender economic asymmetry.[27].

The fertility and policy squeeze

The third major component of the drive for sex selection relates to fertility decline and its impact on gender composition of the family. Table 2 illustrates this by showing the probability of various events in relation to the fertility levels (i.e. gender-blind fertility). Even if mortality is factored in, it appears that only few people may fail –statistically speaking– 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 so much have exacerbated the need for sons than the risk to remain sonless.

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[26] Female infanticide before the 20th century was most notably reported in North-west India and in East China (Caldwell and Caldwell, 2005).

[27] 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 or urban middle classes) will be especially responsive to gender bias aspects related to rituals, prestige and financial transactions. Lower-status or lower-income groups, such as unskilled workers in South Korea or China, backward castes and tribes in India, ethnic minorities in China and Vietnam, are therefore in a different position, and son preference is usually less acute among them. Similarly, groups following uxorilocal customs in rural China or intra-family marriages in South Asia will be less inclined towards discriminating against their daughters.

The next row in the table describes the tolerance for female birth, i.e. the acceptable proportion of female births when parents need at least one son, which is shown to decrease drastically as fertility declines. Without recourse to prenatal sex selection, the average number of supplementary births necessary to bear a son remains the same: 1.95 children with a normal SRB of 105. However, its overall impact on total fertility augments rapidly as fertility declines and the probability to have no son increases. 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 are almost expected to beget another 2 children to ensure the birth of a single son. Doing so, they would moreover end up on average with three daughters, an especially unwanted outcome if the aversion for girls (e.g. due to dowry costs or fine for excess fertility) is as acute as the need for a son.

Such figures strongly militate against the reliance of parents to the "stopping rule" since 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. It comes therefore 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 SRB of higher parity births, when sonless parents realize that they may end up with no son, tends to be much higher. For instance, the SRB for Western India has been estimated at 107 for first births, but 110 for second births and 114 for later births. Figures for parity 2 and 3 would rise respectively to 115 and 132 among women with no son alive[28]. Similarly, data indicate a sudden SRB rise among third births during the 1980s in South Korea during the 1980s and a decade later in Caucasian countries (Park and Cho, 1995; Meslé *et al,.* 2007). As expected, this increase of parity specific SRB is itself 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 was above 140 in 2005 while first-order births displayed almost normal SRB levels (Goodkind, 2008).

Reductions in average number of children create therefore an obvious "fertility squeeze" for parents expecting the birth of a son[29]. This constitutes an independent third precondition for active sex selection. The squeeze element is however almost absent among populations with high fertility who have lesser 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 behaviour would be almost imperceptible[30].

In addition to the effect of spontaneous fertility decline, forceful government fertility policies in China, or to a lesser extent in Viet Nam, tend to 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 birth. For a large part of rural East China, where the second birth was conditional on the first birth of a daughter, the parents' gender equation has in fact been incorporated in population policy[31]. This provision, in itself a vivid manifestation of gender discrimination, corresponding to the recognition by Chinese authorities of the acute demand for a male descendant from peasants and other rural households. The

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[28] Estimates by Retherford *et al.* (2003) based on NFHS-2 data. See also state-wise estimates derived from sample registration figures (Bhat, 2002: 5257).

[29] The squeeze effect described here corresponds to some extent to the so-called "intensification" factor (*i.e.* higher parity specific discrimination level) described by Das Gupta and Bhat (1997).

[30] For instance, if sonless parents with an average fertility of four were to have only sons for the fifth birth, the overall SRB would rise only to 107.9. See however our comments below on infanticide and daughter aversion in high fertility settings.

[31] Second-child permits to parents of a girl were gradually introduced from the early 1980s onwards in most rural China. See Sharping (2003: 97-101) for details and Gu *et al.* (2007) for an overview local fertility policies.

wider dilemma faced simultaneously by both families and governments in order to achieve low fertility at the expenses respectively of male offspring and gender equity resulted in China's "gendered families" (Greenhalgh and Winckler, 2005). Such situation goes a long way to explain the governments' relative apathy in many Asian nations to the growing resort to sex selective abortion by households trying to meet simultaneously their gender and fertility requirements.

It must be remembered that many initially blamed the strict family-planning regulations in China for reported cases of infanticide and sex-selective abortions. This is a somewhat deceptive 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 western countries. But whatever its local political context, fertility decline does reinforce the need for sex selection everywhere by discouraging the use of the age-old strategy of trial-and-error through repeated pregnancies and represents therefore a distinct component of active sex selection.

As the pressure to abort girls builds up when the fertility norm decreases, we may think of a threshold level at which low fertility would automatically create "squeeze conditions". For instance, an average of 25% of parents with 2 children will remain sonless (Table 2): it may be imagined 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. In order to test whether given fertility levels could be associated with the inception of large-scale sex selection, we have estimated the fertility levels in various countries (and regions) on the year when the SRB crossed the 110 mark[32]. These years extend from 1981 in Punjab to 2006 in Viet Nam. But the corresponding TFR estimates for the same years appear to be equally heterogeneous. In India as a whole, the TFR (in 1990) was then 3.8 when birth masculinity reached 110 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 birth masculinity crossed 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 then from 1.8 in Georgia to 2.5 in Azerbaijan[33].

The absence of strong link between the timing of fertility decline and birth masculinization should serve as a reminder that fertility *per se* is not the only predictor of gender discrimination. Fertility decline does exacerbate demand for sex selection, but many other factors are also at play. Which bring us back to our initial RAS (Ready-Able-Squeezed) model in which the characteristics of the two other factors also determines the overall level of gender discrimination.

Synthesis

The accompanying chart (Figure 2) sums up the main factors associated with the three preconditions to sex selection: access to modern sex selection technology with liberal abortion legislation (*able*), moral acceptance of sex selection and socially grounded preference for sons (*ready*), and low-fertility pressure (*squeezed*). In a synthetic model of propensity for sex selection, the outcome score in a given setting would thus be the product or the smallest value of the three R-A-S dimensions. In practise, identifying the weakest link is often enough for understanding the absence of pronounced sex

[32] When annual SRB series are not available (such as for the whole of India and Chinese provinces), we estimated crossing years by linear interpolations 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 Scheme in India and from *Fertility Estimates for Provinces of China, (1975-2000)* for China.

[33] The same exercise conducted for the 115 SRB levels demonstrate a similar heterogeneity in TFR levels, extending from values well below two in West and East Asia to values above 3 in many Indian States such as Haryana, Gujarat or Bihar.

selection in various settings. We may for instance explain the case of Iran or Thailand by the lack of son preference, that of Viet Nam before 2000 and possibly of Caucasian countries before 1990 by the near absence of efficient prenatal diagnosis methods, and finally the case of Nepal and Afghanistan by the still weak fertility squeeze effect due to current high fertility levels[34].

The proportion of male births, when above normal biological levels, is thus constrained by one or two factors[35]. Comparing the distribution of SRB values in Asia, we may therefore presume the considerable role played by son preference in Northwest India. In fact, as our analysis in the previous section has shown, the SRB has reached exceptionally levels in this region as soon as modern sex selection technology emerged, but long before fertility approached the replacement-level. The bias against daughters must have been extremely acute to explain such a rapid diffusion of selective abortions in this part of India. On the contrary, stringent fertility regulations in rural China must have had a determining impact on gender discrimination. Lack of exhaustive statistics to capture adequately these components prevents us from attempting a more detailed decomposition of the kind undertaken by Lesthaeghe and Vanderhoeft (2001) for fertility decline, but subsequent research needs to evaluate in greater detail these distinct dimensions in order to assess potential risks of sex selection in still unaffected areas with biased gender preference.

Why would birth masculinity return to normal?

Recent statistics may suggest that the rise in sex ratio at birth may come to a halt, but the previous analysis of the three components of gender discrimination provides us with better conceptual tools to frame the possible pathways of birth masculinity in the future. For many reasons, prospects may not however appear favourable at first view since many social and demographic trends currently observed portend a potential deterioration of sex ratio at birth in future.

Intensification and Diffusion

Two mechanisms have been already observed, those of intensification and diffusion of sex selection. Intensification refers to households practicing more rigorous sex selection and this applies to regions or countries in which fertility is still falling down. Further fertility decline in South Asia will in particular exacerbate the squeeze factor and may ultimately affect also first-order pregnancies. A different source of further deterioration of the sex ratio situation stems from propagation mechanisms that could reach epidemic proportions in countries like India or Viet Nam, where high SRB is still limited to specific regions or communities. Diffusion processes could be in part directed towards all groups of local society, and would proceed as a top-down phenomenon as was the case for fertility decline. In many countries, the supply of modern reproductive technology is still limited and abortion illegal[36].

Moreover, when high sex ratio is associated with better economic status or education level, the current rapid social and economic developments in Asia constitute structural factors likely to stimulate the upward mobility of millions of households and indirectly spread sex selection practices. Increasing

[34] The potential role of prenatal diagnosis equipment in explaining the late rise in SRB in Viet Nam is explored in Guilmoto *et al.* (2009).

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

[36] An example of this unmet demand for sex selection in South Asia comes from the reported number of Nepalese women from the Terai region crossing over to India to go to private clinics for sex selective abortions.

affluence, education and urbanization could therefore mechanically translate into increasing demand and access to sex selection. Easier access to sex selection techniques fuelled by future technological improvements and by raising income levels is bound to bring birth masculinity to frontier levels in which parents would be able to avoid all undesired female births. It is therefore apparent that many countries and regions, extending beyond South and East Asia towards the Middle-East or Africa, may be prone to deterioration in SRB levels in the future and requires close demographic monitoring.

The case for a long-term SRB recovery

We however consider that the social and economic pressure for gender discrimination will by itself diminish over time in many affected areas. Of all the preconditions listed in our framework, only the demand level is likely to make a difference in this respect. Son preference is based on norms and values that have long been considered as immutable, a legacy of gender and kinship arrangements reinforced by local institutions and religious systems. But at the same time, the empowerment of Asian women is improving on several fronts in spite of their increased vulnerability in the womb. This growth in human capital and economic capabilities grant women stronger autonomy and economic self-reliance, and may undermine the foundations of a patriarchal system based on their submission and exploitation. All this will contribute to a rapid weakening of some traditional customs and to the promotion of more gender-symmetrical family arrangements.

Many changes are already underway concerning male-biased rituals (such as the cult of ancestors), marriage transactions and inheritance patterns that bear the marks of the patriarchal system[37]. Traditional joint family arrangements are also becoming less frequent in areas such as rural China. The role played by daughters in old age support is growing in spite of traditionally patrilineal solidarity systems. The increasing contribution of women to the rapid economic development occurring in many areas of East Asia has also been accompanied by a gradual "retreat from marriage" characterized in particular by late marriage and by rising levels of singlehood (Jones, 2007). All these current transformations run counter to many old patriarchal institutions in which women's availability as wife and mother is at the core of the reproductive system and only the male line responsible for the welfare of the elderly.

South Korea's experience in this matter appears crucial as the rapid economic and social uplift of women undoubtedly contributed to the fast disappearance of the age-old gender bias. The recent study by Chung and Das Gupta (2007) stresses in fact the role of social change –encompassing both structural transformations and more importantly a gradual weakening of male-oriented social norms– in SRB's rapid return to normal. Cohort replacement and further education of women are also seen by Lin (2009) as factors of greater gender indifference in Korea and Taiwan. Regarding South Korea, it must be added that the change in the legal environment, starting from the 1980s, has been most probably a significant factor. Several new gender-sensitive laws such as the *Sexual Equality Employment Act* of 1987 were also introduced and the patriarchal family law enacted in 1948 was revised in 1989[38].

A different illustration of the SRB downturn comes also from a diffusion perspective as we have previously seen that higher social strata initiated the decline in South Korea. In mainland China, for

[37] 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 on joint family property after marriage – coparceners in land property (Agarwal, 2005).

[38] Gender-related laws are summarized in Cho (1994) and analyzed in greater detail in the various issues of *Women's Studies Forum* published by the Korean Women's Development Institute in Seoul. Several legislations were introduced more than 30 years ago when the political system was democratized.

which disaggregated SRB data are available, the SRB is lower among both the highest educated segment of the population as well as in large cities, further socioeconomic progress may in fact bring down its level[39].

We have mentioned so far factors that could be labelled as structural or exogenous since they tend to influence the gender system from the outside. But a different, more internal factor is also likely to contribute to lower sex ratio levels in the future. High sex ratios at birth are bound to result in excess numbers of adult males after twenty years. Several studies have already charted the magnitude and the impact of excess SRB on the future age and sex composition of the population.[40] They indicate the extent to which disequilibria currently affecting birth cohorts will be felt after two decades among young adults by creating a huge 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[41].With women likely at the same time 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 an entirely different demographic environment, having a son that may never marry would soon represent a serious social or economic hazard. It is ironical that the very precepts that fuelled the initial craze for sons (and the parallel aversion to daughters) would deal a fatal blow to the patriarchal system. But this typically corresponds to the kind of endogenous responses factors that account for the specificity of transitional cycles. The most common illustration in demography remains, of course, the feed-back impact of falling mortality on fertility behaviour, a mechanism lying at the core the demographic transition itself[42].

A Tragedy of the Commons in the Making

In conclusion, it is necessary to assess the implications of imbalanced sex ratios beyond the various benefits expected by parents of sons. Sex selection at birth is one of the most blatant manifestations of systematic gender discrimination and it remains somewhat underemphasized in many analyses of women's disadvantages[43]. But as long as abortions are 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

[39] The 2005 tabulations indicate that SRB in Chinese cities (115.1) is lower than in towns or in villages. Further processing of the raw data from the 2005 survey further shows that the SRB of births from mothers with college education is of 112, a level significantly lower than that of lesser educated women (work in progress conducted with Ren Qiang). Similar characteristics were observed in the 2000 Chinese census.

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

[41] 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.

[42] See for instance Reher and Sanz-Gimenez (2007). Another close analogy can be drawn with the "migration hump" described by Martin and Taylor (1996) or with the so-called Kuznets's environmental curve (Dinda, 2004).

[43] A lot of research and data tend to focus on gender-based inequality across or within countries and try to capture the various 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) now incorporates the SRB into its synthetic indicator of gender inequality.

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 imbalanced 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 behaviour of households 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 biological laws, parents do not contribute their due share of girls to the common demographic pool – a contribution necessary for the equilibrium of the entire marriage and family system. Such behaviour is typical of free riders and, seen from a wider perspective, environmental economists will recognize the characteristics ingredients of a tragedy of the commons, the archetypical social trap in which free access to a public resource by individual interests leads rapidly to the complete depletion of the original shared resource (Hardin, 1968). While at first sight the sex-ratio situation does not entail "irreversible" transformations (the way, for instance, deforestation and climate change do), demographic forecasts indicate however that it will take more than 50 years for the age and sex distributions to recover. As a consequence, the number of male generations to be affected by the current sex ratio transition appears potentially extensive and the aggregate loss in well-being considerable.

The opportunistic behaviour of individuals (here the avoidance of female births) remains in fact largely invisible to other society members. For one, the monitoring of sex selection is difficult, except at the statistical level. Those who discriminate against female foetuses are also those who have more girls on average (this being the reason why they opt for sex selection in the first place). They do not therefore feel guilty of gender bias. Moreover, the overall impact is not perceptible before 25 years and will ultimately affect all families, including the majority who had boys without resorting to sex selection. All this militates against the feasibility of many institutional responses based on cooperative action as often prescribed to fight negative externalities of this type in small communities (Ostrom, 1990).

Inducing change

We have already seen that two key components of the push for masculine births –access to efficient sex selection and low fertility– will probably contribute to a worsening situation in the years to come as skewed sex ratios at birth may spread to new regions, ethnic groups and social classes[44]. Greater gender equity and gender indifference appear as the main way out of the sex ratio stalemate, with respectively marriage squeeze and social change as the two likely triggers.

The first factor of change –demographic imbalances and male surplus– will have an unavoidable impact as perceived male scarcity may soon be replaced by overabundance. But its full impact will be postponed by several decades, a typical feature of tragedies 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 factor of the decline in son preference –transformations of gender systems– are more difficult to anticipate.

[44] 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 in greater detail the complex relationship between fertility policy and SRB in China.

Traditional social systems may offer strong resistance to the assertion of women's autonomy and to the dilution of male social predominance. Women's reduced demographic weight in society might in fact give them a lesser role in political decision-making. Elite groups that have long promoted patriarchal ideologies should play a key role in this change. This is why the SRB may be expected to decline first among the higher strata of society and in metropolitan areas. Korea's past experience and the traces of current SRB decline in urban areas in India and Azerbaijan mentioned previously corroborate this reasoning.

As is the case for unsolvable externality problems that characterize environmental tragedies, action by governments and other third players may however 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 been gradually reinforced or widened in various countries, starting with China and India[45]. Some of these measures, if properly enforced, will in fact raise the overall "cost" of sex selection and delay its future diffusion across the population. To a large extent, the effectiveness of repressive measures on sex selective behaviour remains still uncertain and new emerging technology might render them obsolete. Not to mention that such restrictive policies run the risk to wrongly target legitimate abortion users or providers. But at the same time, we should emphasize the rapid and vigorous legal response that took place in South Korea: Not only was prenatal sex identification outlawed as early as 1987, but doctors were from 1990 onwards threatened with heavy fines, suspension and loss of license. As was observed by Park and Cho (1995: 80), 1990 happened to be the peak year before SRB's decline in South Korea. The Korean Medical Association later launched a large media campaign in 1995 against sex determination. The recent analysis of Korea's sex ratio turnaround however makes no mention whatsoever of the more repressive measures on sex determination introduced earlier by the South Korean government, leaving open the question of the potential impact of restrictive legislation on discriminatory behaviour in other Asian countries where it has been introduced and recently strengthened[46].

Interventions towards greater gender equity by governments in Asia will accelerate normative change in society. Governments will try to alter the gender equation with respect to son preference in various ways by extending specific support to girls and their families. Such policies of positive discrimination would contribute to levelling out the cost and benefit advantage of boys. Yet, policies based on subsidies are potentially very expensive if they involve financial transfers and special benefits granted to families of girls unless governments dare one day to tax the birth of sons. Other measures by governments or NGOs in the field of advocacy entail campaigns of information and awareness on gender issues. While probably slower to take effect, such campaigns will combine with changing gender attitudes stemming from social transformations in Asia. It may be added that research on the impact of various policies on SRB is still in its infancy and the effectiveness of restrictive measures on sex selective abortions remains poorly documented.

Better statistical monitoring of birth masculinity through civil registration is yet another essential ingredient of any efficient policy in Asian countries where vital statistics have long been severely

[45] The comprehensive approach adopted by Chinese authorities as part of the "care for girls" program includes in particular various incentives and sensitization campaigns, but the government has refrained from adopting a more repressive legislation in 2006 (Li, 2007; Tan, 2008). On India's PC-PNDT Act, a more repressive piece of legislation was passed in 2003, see Josef (2007).

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

incomplete[47]. In addition to this, the fate of surplus male generations that have already started accumulating in specific subregions has already attracted large press coverage in countries like India. The role of the press is in fact considerable in spreading information about gender imbalances as well as about their consequences (prolonged celibacy, atypical marriage migrations, trafficking of women). As a matter of fact, one of the main recipes for fighting a tragedy of the commons consists in dispelling the "cloud of ignorance" (Hardin) and informing actors well in advance of adverse long-term consequences of their behaviour. After demographers who have played a key role in demonstrating the extent of the mounting sex ratio crisis, documentation gathered by journalists and social scientists on the situations of men and women facing a serious marriage squeeze will highlight the unsustainability of the current gender regime and may accelerate changes in gender valuation.

Conclusion

The first noticeable rise in SRB associated with prenatal screening of births in Asia dates back to the 1980s. It is now possible after more than two decades to identify some commonalities in this initially unanticipated change in birth masculinity. Sex selection can be fruitfully analyzed by adapting the theoretical framework introduced by Coale for explaining the process of fertility decline of which change in SRB may an integral part. The three necessary preconditions of this revolution in gender discrimination were identified in our R-A-S model as entrenched traditional preference for sons in patriarchal societies ("readiness"), access to modern sex selection ("ability") and the pressure due to 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 attempt a ranking of these three determinants of sex selection in order to better assess their respective impact in the current masculinization processes. But an in-depth analysis of these three factors is made difficult by the lack of proper comparative data, especially on the relative access to sex selection methods, which are usually illegal. The specific role of the supply factor remains also problematic. We may argue–in a fashion similar to Pritchett's (1994) critical treatment of contraceptive access in the explanation of fertility decline– that the demand for sons is the only factor behind sex selection and that supply of sex selection facilities merely represents the response to gender needs in a given technological environment. However, modern, efficient sex selection is based on abortion and prenatal diagnosis, methods not available everywhere which, for this reason, often cohabit with age-old discriminatory techniques. It has even been conjectured that fertility decline in some regions such as the Middle East was in part hindered by poor access to prenatal screening or to abortion by parents insisting on the birth of a son[48]. In such a configuration, the unmet need for sex selection would therefore encourage additional childbirth (or resort to cruder sex selection methods), offering a case in which the potential interplay between different preconditions for sex selection seriously complicate the overall picture. Another instance of complex interaction mechanisms is found in the weakening of religious norms against abortion in the face of the exacerbated need for avoiding unwanted births, a trend observed among many populations –from Azerbaijani Muslims to Buddhist Koreans– where

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

[48] This hypothesis has been recently put forward by Courbage and Todd (2007: 79). Available data on both son preference and differential stopping behaviour demonstrate the gender preference in countries such as Syria, Jordan or Egypt (Williamson, 1976; Cleland *et al.*, 1983; Filmer *et al.*, 2008; Yount *et al.*, 2000). Sex differentials in mortality may however be on the decline in the Middle East (Yount, 2001).

fertility decline has been rapid. There are therefore persisting difficulties in adequately accounting for the separate influence on sex selection born by the three factors we have singled out.

Statistical monitoring indicates however that SRB levels do not tend to increase endlessly to levels beyond 140 male births to female births, and that an incipient downturn appears discernible in several regions of Asia. According to the hypothesis of a sex ratio transition, birth masculinity would tend to plateau at certain thresholds and may decrease subsequently as has been observed in South Korea. This proposition accords with the larger perspective borrowed from resource economics in which resource overexploitation leads to subsequent behavioural readjustments. A more sociological perspective provides additional explanations of why the sex ratio at birth would ultimately decrease back to normal levels under the influence of social and economic change as well as with a nudge from governments to monitor sex selective behaviour. While probably difficult to predict by sociologists and economists[49]. changes in family systems or in gender preference will probably be the main levers of future improvements in SRB. The sex ratio transition corresponds therefore to a limited time window during which the demographic regime registers a pronounced destabilization and creates a large male surplus till the system corrects itself during a subsequent phase.

Nevertheless, prospects for a speedy improvement of SRB remain limited today and South Korea's story is probably not going to be replicated everywhere at the same pace. Degradation of the SRB in several parts of Asia is a distinct possibility in the next ten years and the mere pressure effect generated by further fertility reduction in South Asia is, for instance, likely to spur more couples to eliminate unborn daughters. But in other areas, from Northwest India to Coastal China, where birth masculinity seems to have already reached its upper limit, numerous signs of stagnation or decline are now visible and the transition may enter a second phase characterized by a progressive reduction in sex selection in the forthcoming decades. We have also envisaged a possible deceleration in the supply of sex selection services, under the impact of direct intervention by public authorities through awareness campaigns and regulations. Action by government and civil society organizations will be a crucial element to facilitate SRB's downturn and to alleviate the consequences of current gender imbalances at birth. The laissez-faire attitude that has so far prevailed, often prompted by entrenched Malthusian considerations from government authorities, has only added to the burden of future adult generations.

[49] See for instance the work on the endogeneity of gender preferences by Leung and Zhang (2008). An attempt at modelling the relationship between SRB and fertility decline suggests that SRB may in fact ultimately fall, given the assumption that "parents prefer a married daughter to an unmarried son" (Yoon, 2006). This is precisely the dilemma patriarchal institutions may be facing soon unless society gets divided into prosperous bride takers and underprivileged bride providers.

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Appendix

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

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Table 1. Recent measurements of sex ratio at birth and child sex ratio in countries and regions of Asia and Europe, 2000-2008

Country	Selected regions	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	115.8	2005	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

Notes: Most recent year available. Regions shown for China and India have the highest SRB levels.
Indicator: SRB= sex ratio at birth; SR04= sex ratio below 5
Data source: described in Appendix 1

Table 2. Fertility and family gender composition

	Number of children						
	6	**5**	**4**	**3**	**2**	**1.5**	**1**
Probability to be sonless*	1%	3%	6%	12%	24%	34%	49%
Tolerance for female birth **	83%	80%	75%	67%	50%	33%	0%
Additional effort required to bear a son ***	33%	39%	49%	65%	98%	130%	195%

* Probability of female-only births

** Highest proportion of female births tolerated by parents expecting at least one son

*** Average additional births (1.95) needed for sonless parents to bear a son expressed as a percentage of average number of children.

Figure 1. sex ratio at birth in Azerbaijan, China and South Korea, annual variations and three-year moving averages, 1970-2006

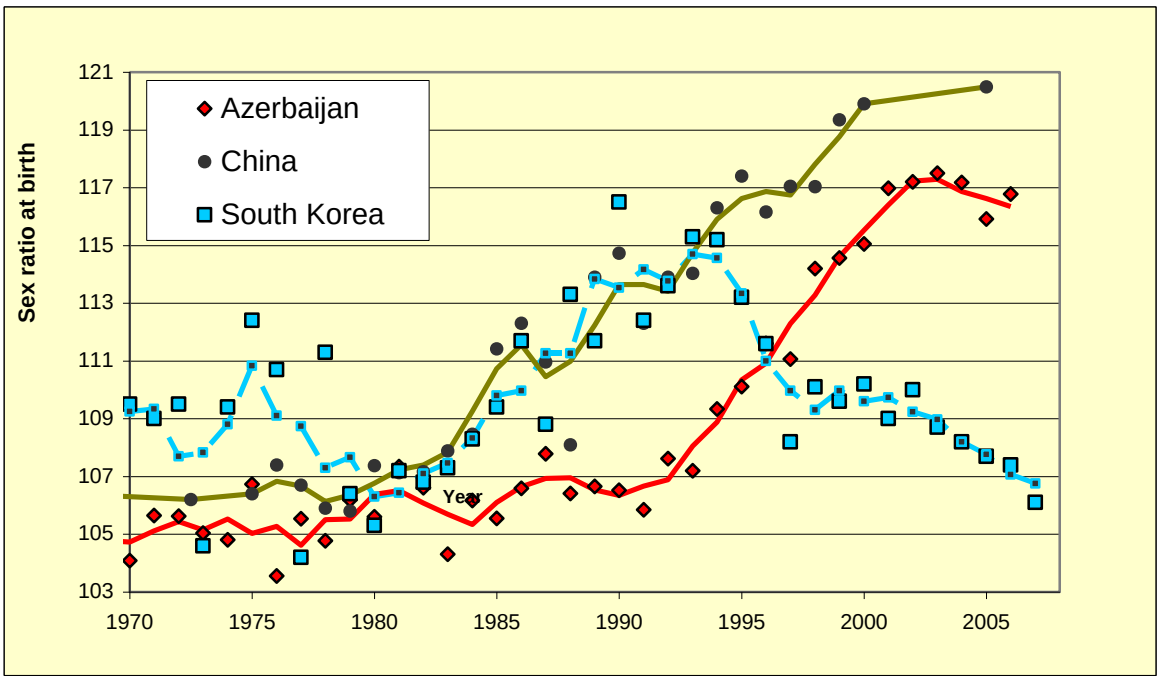

Figure 2. Sex selection preconditions and associated factors