



## OVERVIEW OF A POPULATION QUESTION

With the article on the masculinization of births *Population* is launching a new series of annual chronicles coordinated by Dominique Tabutin and devoted to the state of world knowledge on a topical demographic issue. Targeting a broad audience of scientists, students, journalists and more, these chronicles will combine factual data with an overview of the theoretical and political aspects of the question in hand. By approaching topical issues in historical perspective, these articles will shed light on their wider context. After a critical description of information sources and measurement tools, an overview of recent research will describe ongoing trends and pinpoint social and spatial disparities. A discussion section will then explore the political or legal implications of the current and future situation, and the challenges facing researchers. Statistical and methodological appendices may also be included.

The new series is inaugurated by Christophe Z. Guilmoto, who examines the question of the sex ratio at birth, which in humans naturally stands at around 105 boys per 100 girls. Scholars have long been interested in measuring variations in this ratio at different times in history, and among different populations or communities. The first accurate estimate was made by John Graunt in 1661, who found a ratio of 106.8 boys per 100 girls among infants christened in London. According to United Nations estimates, recent changes in sex ratios in certain populous countries of the world, such as India and China, have raised the global sex ratio from 105 in 1975-1979 to 108 in 2005-2009 (*World Population Prospects: The 2012 Revision*). These recent increases in the proportion of male births have been attributed to gender discrimination. In this article, the author analyses the mechanisms and causes of this phenomenon and discusses its social and political implications.

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*Population* editors



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Christophe Z. GUILMOTO\*

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## The Masculinization of Births. Overview and Current Knowledge

When Amartya Sen sounded the alarm 25 years ago on the millions of “missing” women in the world, the relative deficit of females and preponderance of males could mainly be ascribed to excess female mortality (Sen, 1990). The proportion of males in the world population moved above 50% in 1955, chiefly owing to skewed sex ratios<sup>(1)</sup> in Asia, and increased slowly but continuously from that date. But since the 1990s, an abnormal rise in the proportion of male births has also been observed in several countries. The sex ratio at birth (SRB) in those countries is now between 110 and 115 boys per 100 girls (Table 1), compared with a general norm of 105. Sex selection before birth has in turn become an instrument of gender discrimination, accentuating the gradual rise in the demographic weight of men, a trend for which the United Nations foresees no reversal before 2030 despite increases in female life expectancy, which is much higher than that of males.<sup>(2)</sup>

These skewed sex ratios at birth have obliged demographers to revise some of their assumptions. According to the first of those assumptions, demographic changes are mainly a result of changes in fertility, mortality or migration and are expressed through age structures, with the sex ratio remaining a secondary aspect of population dynamics. The second assumption is that emerging Asia is a model of successful demographic transition, with lessons to be learned by the rest of the world. In addition, its recent evolution suggests that, through a mechanism of historical convergence, it will move towards the demographic regimes of the industrialized countries at an ever faster pace. The third assumption is that advances in reproductive health and human development

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(1) The sex ratio refers here to the number of males per 100 females (see below for the definitions of the sex ratio).

(2) According to the UN's long-term forecasts, there will be more males than females in the world until the end of the century. The situation is primarily due to Asia; the rest of the world has had a female majority for over 50 years.

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Table 1. Sex ratio at birth (SRB) in selected countries, 2008-2014

Country or region	SRB <sup>(a)</sup>	Period	Source	Population <sup>(b)</sup>	Fertility <sup>(c)</sup>
<b>Asia</b>					
China	115.9	2014	National Bureau of Statistics	1,401.6	1.7
South Korea	105.3	2013	Birth registration	49.7	1.3
Hong Kong <sup>(d)</sup>	109.3	2013	Birth registration	7.3	1.1
India	110.0	2011-2013	Sample registration System	1,282.4	2.5
	110.1	2012	Birth registration		
Singapore	107.0	2013	Birth registration	5.6	1.3
Taiwan	107.4	2012	Birth registration	23.4	1.2
Vietnam	112.2	2013-2014	Intercensal survey 2014	93.4	1.8
<b>Southern Caucasus</b>					
Azerbaijan	115.6	2013	Birth registration	9.6	1.9
Armenia	114.0	2012-2013	Birth registration	3.0	1.7
Georgia	108.0	2012-2015	Birth registration	4.3	1.8
<b>Southeast Europe</b>					
Albania	109.0	2012-2013	Birth registration	3.2	1.8
Kosovo	110.4	2011-2013	Birth registration	1.8	2.3
Macedonia (northwest) <sup>(e)</sup>	110.4	2009-2013	Birth registration	0.3	1.5
Montenegro	109.0	2009-2013	Birth registration	0.6	1.7
<b>Rest of world</b>					
South Africa	101.7	2012	Birth registration	53.5	2.4
Germany	105.3	2013	Birth registration	82.6	1.4
Brazil	104.8	2012	Birth registration	203.7	1.8
France	104.8	2013	Birth registration	65.0	2.0
USA	104.7	2012	Birth registration	325.1	2.0
Japan	105.2	2012	Birth registration	126.8	1.4
Russia	105.7	2013	Birth registration	142.1	1.5
Turkey	105.8	2013	Birth registration	76.7	2.1
<p>(a) Sex ratio at birth (number of boys per 100 girls).                      (b) Estimated total population in millions in 2015.                      (c) Average number of children per woman in 2010-2015.                      (d) The data for Hong Kong concerns births among residents.                      (e) Northwest Macedonia corresponds to the region of Polog, for which we have estimated the corresponding fertility rate.</p> <p><b>Sources:</b> Sex ratios in Europe are based, wherever possible, on national vital statistics, but the other sources are indicated where that is not the case. Where population numbers are small or fluctuating, the figures are aggregated over several years. Population and fertility figures are based on the estimates of the United Nations Population Division and the World Bank (Kosovo).</p>					

– and notably progress in education for women – will inevitably reduce inequalities between the sexes and their demographic impact.

The masculinization of births observed since the late 1980s has undermined these assumptions. Prenatal sex selection has transformed the demographic regime through an unexpected mechanism. The sex ratio at birth, long considered as a demographic curiosity and relatively misunderstood, has now become a marker of silent practices that have led to the worldwide disappearance of millions of unborn girls. Further, the demographic modernity of Asia, illustrated by a demographic transition often seen as exemplary, is associated in China and India with one of the most singular forms of demographic change, one with no equivalent in the history of populations in the rest of the world. And what's more, it is the development of education, economic progress and growing control over fertility that underpin this sudden wave of discrimination against female births. On this issue, demographers have rediscovered their capacity to use statistics as a means to reveal private and reputedly invisible behaviour, achieving a level of detail to which no other social science could aspire. Thanks to demography, gender researchers now have the means to assess the scope, magnitude and repercussions of one of the most radical forms of sex discrimination.

In response to the growing literature on this topic (Park et al., 2012), this article aims to make a broad overview of imbalances in sex ratios at birth and to explore current knowledge on the question.<sup>(3)</sup> We only have space here to summarize a handful of these studies and will merely touch upon the parallel phenomenon of excess female mortality, commonly observed in the same world regions and likewise in western Europe until the 1930s (Tabutin and Willems, 1998; UN, 2001).

The article begins with a section on methodology, stressing the inadequacies of sources and our incomplete understanding of the current situation. Section II looks at recent data and trends that show how, in the last few decades, prenatal sex selection has been highly concentrated in certain world regions. That question is pursued in Section III with a review of the social and demographic disparities that are of considerable interest to our understanding of the phenomenon. Section IV takes an in-depth look at the three main intermediate variables of sex selection and gives an interpretative framework for assessing the current situation and anticipating possible future scenarios. Section V addresses the current and future impacts of these imbalances, notably from a demographic standpoint. Section VI broadens the debate and reviews possible policy responses to these discriminatory practices. The article concludes by sketching out four key avenues for future research.

(3) Other work, mainly on Asia, proposes a more recent examination of the question. For example, see Attané and Guilmo (2007), Dyson (2012), Gilles and Feldman-Jacobs (2012), Guilmo (2009), Pison (2004), and UNFPA (2012a). Anthropological aspects are analysed in a comparative approach by Croll (2000) and Miller (2001).

## I. Measures and sources

Confusion over the causes of skewed sex ratios at birth is rife and has long resulted in a lack of understanding of the discriminatory mechanisms at play in some parts of the world. But it appears that the social factors underlying these imbalances are much better understood than biological factors such as age or parity that are assumed to affect sex distribution at birth.

### 1. Definitions

Biologists distinguish between the primary sex ratio, i.e. at conception, and the secondary sex ratio, at birth. Our main focus here is on the secondary sex ratio, namely that of live births, or the sex ratio at birth (SRB). Intra-uterine mortality and stillbirth are not addressed here. Moreover, the primary sex ratio is practically impossible to calculate on significant samples, and so is considered as higher than the secondary sex ratio owing to the considerably higher intra-uterine mortality rate of male fetuses (Di Renzo et al., 2007). However, recent work suggests that embryonic mortality could be unfavourable to girls during the first few weeks following conception and the primary sex ratio may be closer to parity than previously suspected (Orzack et al., 2015). Consequently, prenatal mortality probably leads to a decrease in the sex ratio during the intra-uterine phase, but only the SRB is actually measurable.

Compared to the complexity of mortality and fertility indicators, calculating the sex ratio at birth hinges on one of the simplest ideas in demography, namely the ratio of male to female births. Yet this ratio is rarely expressed in the same manner from one discipline and world region to the next, as demonstrated by recent figures for France and China (Table 2). Biologists favour the proportion of male births and use it directly as an indicator of frequency for statistical measures of variation. But the figures are unintuitive and difficult to differentiate without adding two or, even better, three figures after the decimal point. Expressed in this manner, the proportion of male births is 0.537 in China (i.e. 54 male births per 100 births) and 0.512 in France. Demographers and other social scientists prefer to use sex ratios, some of them opting for a unit calculation that gives the figure of 1.16 for China (1.16 male births per female birth) and 1.05 for France. But for more precision, the most common practice is to express the number of male births per 100 female births, i.e. 115.9 for China and 105.1 for France.<sup>(4)</sup> This last standard will be used in this paper. India, for its part, has staunchly refused to adopt these practices and applies its own method. Its statistical interest in the sex ratio dates back to the first colonial census of 1870-1871. The SRB has been measured since that time by the ratio of female births – an indicator that is better adapted to a deficit of girls – and is calculated

(4) The website of the United Nations Population Division (<http://esa.un.org/unpd/wpp/index.htm>) and the demography manual published recently by the IUSSP (Moultrie et al., 2013) calculate male ratios both as unit ratios and per 100.

**Table 2. Four common indicators of the sex ratio at birth illustrated by Chinese and French statistics.**

	China	France
Proportion of male births	0.537	0.512
Male births per 100 female births (sex ratio at birth, SRB)	115.9	105.1
Male births per female birth	1.16	1.05
Female births per 1,000 male births (female ratio at birth)	863	951
<i>Sources:</i> SRB estimates in France (civil registration 2012) and China (annual estimate 2014).		

as the number of female births per 1,000 male births, which gives the figures of 863 for China and 951 for France.<sup>(5)</sup>

It should be added that these measures might be rendered obsolete by a more comprehensive classification of the sexes, for example one that takes account of a “third sex”. This broader categorization system would oblige us to abandon the ratios presented above, which are based on a binary division. A number of industrialized countries and Southeast Asian countries, including Germany, Nepal and Pakistan, have introduced a third sex in their civil registration system or surveys, starting with the Indian census of 2011.<sup>(6)</sup>

## 2. Measurement issues

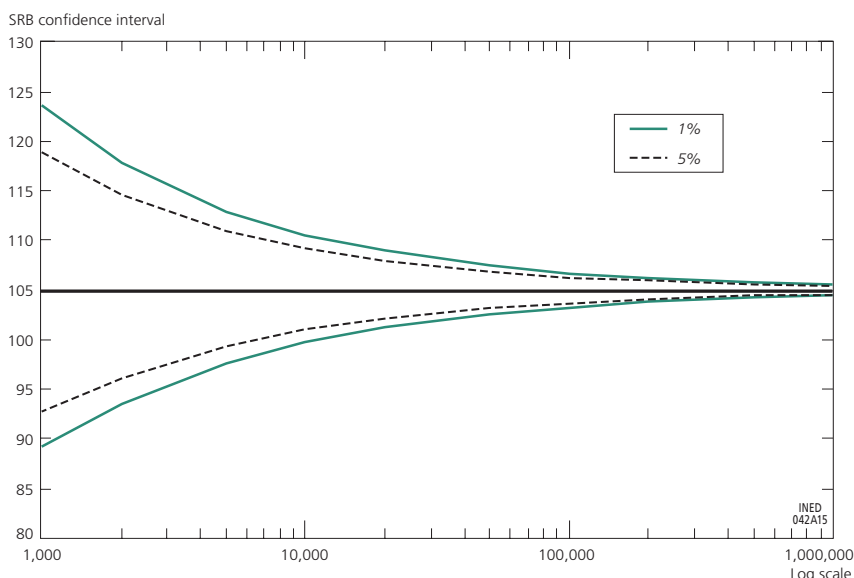
In addition to the limitations of the statistical sources described below, analysis of the sex distribution of births suffers from imperfections stemming from sampling and registration biases. The first arise from the necessarily limited precision of a measure of sex ratios calculated on a small number of observations. As with any proportion, the sex distribution is subject to the effects of a binomial law whereby the precision of the measurement depends on the inverse of the square root of the number of observations. The graph below (Figure 1) sums up that variability by calculating the confidence interval of a sex ratio at birth of 105 based on an increasing number of births from 1,000 to 1 million.

This shows the extent to which the sex ratio calculated on the basis of a small population is subject to random variations. For 1,000 births, the estimate can range from 93 to 119 in 95% of cases and the interval is larger when taking account of 99% of cases. Ascertaining whether a value of 110 male births per

(5) A “rise in the sex ratio at birth” would thus indicate a reduction in male births for Indian demographers but the opposite for everyone else.

(6) In the terms of the 2011 Indian census: “For male, record ‘1’ and for female record ‘2’[...]. Ascertain the sex of the person with reference to the name and relationship to the head [...]. In case the respondent wishes to return other than Code 1 and 2 then give code ‘3’. Please note that it is the respondent’s choice to opt for code ‘3’ (Others). Do not argue or dispute in such cases”. The 2011 census counted half a million people of the “third sex”, or under 0.1% of the total population.

Figure 1. Confidence interval of a sex ratio at birth of 105 by number of births used for the calculation.



Source: Author's calculations.

100 female births is statistically different from 105 would require nearly 8,000 births for a confidence interval of 5%. If the SRB is 108, some 20,000 births would be required for the difference with the normal value of 105 to be significant.

This means that in many countries and regions, the sex ratio cannot be calculated reliably on an annual basis. For example, there are around 7,000 births per year in Montenegro, with a SRB of 108.3 in 2011. The number of births is too low to confirm a distortion of the sex ratio, so the data have to be aggregated over a period of several years (Table 1). Similarly, DHS surveys, often the most robust sources on recent births, record an average of at least 2,000 births a year (figure calculated over all DHS surveys). Even when aggregated over the five years preceding the survey, the estimates are often made based on highly fragile samples. Consequently, many analyses are distorted by the use of overly small birth samples.<sup>(7)</sup>

Under-registration by sex is also a classic bias in demographic sources, from civil registration to censuses. This is particularly true in the registration of births, with those of the preferred sex (generally male) gaining more attention in the recording process. The fear of under-enumeration of female births

(7) Authors of a recent study have not hesitated to point out that the highest SRB was actually observed in Liechtenstein (IHRUC, 2014). This tiny country records under 400 births a year, which renders the estimate worthless.



disrupted the study of sex distribution in India for many years, and the specific impact of excess female mortality remained largely undetected (Visaria, 1971).<sup>(8)</sup> In China, the constraints of the so-called “one-child” family planning policy may encourage parents to conceal unauthorized births, and this primarily concerns the births or population of girls (Goodkind, 2011; Cai, 2014). In contrast, the urban agglomeration of Delhi saw an entirely fictitious jump in female births in 2008 following the introduction of a programme of subsidies for the parents of girls (UNFPA, 2012a). As a consequence, selective under-recording tends to distort the real SRB, but such cases are difficult to confirm in the absence of external data such as census or school enrolment counts (Goodkind, 2004).

### 3. Main data sources

The best possible estimate of the masculinization of births is based on the exhaustive figures of civil registration, which provide annual series of births by sex and region, and even by birth order and month. These data can be used to highlight major variations across a country or among couples. Most industrialized countries provide such data series. But other vital statistics, such as educational level or parents’ marital status, are rarely used when producing summary tables of births by sex. The problem here is that records of demographic data are incomplete in many parts of the world, and vital statistics are either unavailable or unreliable. This is true of China, Nigeria, Indonesia, Pakistan and India, to name but a few of the most populous nations. The data derived from demographic surveys fail to offset the shortcomings of civil registration systems because they do not provide reliable data by year or sub-region, owing to the above-mentioned sensitivity of sex ratio measures to sample size.

Censuses often prove to be the best alternative source of data when vital statistics are incomplete. The age-sex distribution, considered as exhaustive, is the primary data source; it provides a valuable overview of variations in sex ratios between administrative and regional regions, and rural and urban areas at the time of the census, corresponding to births in the preceding years. These data on sex and age are sometimes broken down by ethnic or religious group. The sex ratio of children aged under one is by far the best indicator of the sex ratio at birth during the 12 months preceding the census date. But the figure does require a minor correction to take account of sex differentials in mortality rates after birth.<sup>(9)</sup> Age groups such as under-fives are also used to obtain a larger sample. In addition to differences in mortality by sex, misstatement of age and sex can also serve to further distort the observed SRB. Lastly, while the effect of migration by sex, notably linked to school enrolment, is considered

(8) Particularly complex models are needed to reconstitute historical sex ratios in India (Gerland, 2014; Weldon et al., 2015).

(9) See, for example, the estimates of Kumar and Sathyanarayana (2012) for India.

as fairly negligible before the age of ten, sex-specific under-enumeration may have a disruptive effect, as in the above-mentioned case of China, where a considerable share of female births appear to be omitted in censuses. Another data item drawn from the census corresponds to births preceding the census, as many countries ask women aged 15-49 about their recent fertility. When available by sex, such data can also provide a retrospective estimate of the SRB with no mortality bias.

But censuses are not a perfect solution. They are organized every ten years on average, which is not often enough to monitor annual changes in the SRB. They are missing for some countries, such as Pakistan, where the latest census dates back more than 15 years. Census data also need to be corrected for mortality and for the recording differences mentioned earlier. Finally, some census data exclusively concern the child population, which means that raw data from censuses have to be used to reconstitute information on the parents or family, such as the birth order of children, the educational level of mothers, and the family structure.<sup>(10)</sup>

#### 4. Natural variations in the proportion of male births

The sex distribution at birth is uneven for all animal species. No mammal population for which data are available appears to have an equal number of male and female births (Hardy, 2002). These differences in the SRB are interpreted from an evolutionary standpoint whereby species adapt to their environment, but such theories cannot be confirmed owing to a shortage of figures and studies. According to the famous Trivers-Willard hypothesis, in mammals, the share of male births is higher among dominant groups. This conjecture has sometimes been applied to humans from a sociobiological angle, though with mixed results (Keller et al., 2001; Almond and Edlund, 2007).<sup>(11)</sup>

Yet for several centuries now, demography has provided precise indications on certain invariants observed in human populations. These have been based almost entirely on variations recorded at birth, as the sex ratio at conception is not directly observable. We do know, however, that intra-uterine mortality and stillbirth rates are lower for females, suggesting that the primary sex ratio is significantly higher than the secondary ratio (Gourbin, 2005; MacDorman et al., 2007). Since Graunt and Arbuthnott (Campdell, 2001), observers have recorded a predominance of male births, and this is borne out by vital statistics collected since the seventeenth century. Today we have very large samples of recorded births, both for highly populous countries and in the form of series over several centuries. These series show small variations across countries and

(10) A growing number of samples of census-based individual data are now available thanks to the IPUMSi project (Integrated Public Use Microdata Series, international): <https://international.ipums.org/international/>.

(11) In this respect, Gelman and Weakliem (2009) quite rightly stress the fragility of research on sex ratios based on small population sizes.

periods. The SRB is generally considered to fluctuate around 105 male births per 100 female births but the range is often extended to 104-106 or 103-107 to take account of these variations. The slight historical upward tendencies in the SRB, measured accurately using the statistical corpuses of developed countries, are an ongoing source of debate among biologists (Brian and Jaisson, 2007; Chahnazarian, 1988; Grech et al., 2003). Composition effects by age or by mothers' parity, or the impact of environmental factors linked notably to pollution (Sanders and Stoecker, 2011) have been suggested, but a dominant interpretative pattern has yet to emerge despite the abundance of available statistics. However, the best documented example of inter-ethnic variations concerns populations originating in sub-Saharan Africa, with a ratio clearly closer to 103 than 105, as indicated by DHS surveys in sub-Saharan Africa and the vital statistics of the African-American population in the United States (103.3 in 2012).<sup>(12)</sup> The South African vital statistics give a SRB of 102 in 2012, a figure confirmed by the sex ratio of under-fives among black populations in the 2011 census (101 boys per 100 girls, compared with 105 for white populations).

Another widely discussed source of variation is the circumstantial impact of stress, crises, wars and natural disasters, such as earthquakes, on the SRB. Despite systematic efforts to detect unusual variations following a crisis, the differences measured during these periods remain modest and, above all, contradictory, since both highs and lows in the proportion of male births have been recorded (Chahnazarian, 1988; James, 2009). In France, an increase in the SRB was observed following the two World Wars, while in the USA a decrease was reported after the terrorist attacks of 11 September 2001. Unless the sample of births is very large, these variations of biological origin always appear to be of low or even imperceptible amplitude. Interpretations of these phenomena from a sociobiological or evolutionary biology standpoint remain largely speculative, whereas much more is known about the social and demographic factors behind the masculinization of births examined in the rest of this article.<sup>(13)</sup>

## 5. The demography of sex discrimination

Sex discrimination mechanisms come into play at different phases in the reproductive process, from conception to gestation and through to birth. They are intimately linked to technological progress, which now offers effective and early techniques for determining and manipulating the sex of a future child. In more archaic guise, traditional methods included pilgrimages, religious rituals and special diets during pregnancy thought to favour the birth of a boy. But the effectiveness of such methods appears to have been modest, and we will focus our attention here on other techniques. The order of this overview

(12) See notably Garenne (2002) on Africa and Mathews and Hamilton (2005) on the USA.

(13) Some have ventured a biological interpretation of changes in the SRB in Asia, pointing to hepatitis B in China, despite evidence of variations by birth order (Oster et al., 2010).

does not follow reproductive chronology, since it begins with postnatal methods such as infanticide and negligence and then examines recent methods affecting pregnancies and conception.

### *Postnatal discrimination*

While it has no impact on the sex ratio at birth, postnatal discrimination is part of the panoply of methods used to influence the sex composition of one's children. The most effective postnatal methods are based on three options. The first, female infanticide, was mentioned in China and India in ancient periods in local literature and later in the writings of European travellers, but it has been better documented since the nineteenth century (Caldwell and Caldwell, 2005; King, 2014; Miller, 2007). Female infanticide, often confused with stillbirth, disappeared in China and India only in recent decades (Srinivasan, 2012). The second method, less effective and occurring at a later stage, consists in neglect of girl children. Akin to a passive form of infanticide, it is based on a set of discriminatory behaviours towards young girls in terms of care, nutrition, vaccinations and medical follow-up. It continues to have considerable impact today, as testified by the excess mortality of young girls in numerous countries (United Nations, 2011). The third postnatal discrimination method is the abandonment or placement of children, either through intra-family exchange, agreed sale, infant abandonment, or even human trafficking. The redistribution of children via adoption is a mechanism of this nature, but one that is restricted by the rules governing each society's kinship systems.<sup>(14)</sup>

### *Discrimination during and before pregnancy*

The masculinization of births results first and foremost from the rise in sex-selective abortions. Pregnancies can be terminated on the basis of prenatal diagnoses if the child is not of the desired sex. The most common technique relies on an ultrasound scan to reliably detect the sex of the fetus from the end of the first trimester of pregnancy. Sonography is based on technology dating from the 1960s but medical imaging has made major strides in terms of ease of use, image quality and cost since it came into wider use in the 1970s. As the least invasive way of conducting a prenatal diagnosis, it has replaced the technique of taking samples of amniotic fluid (amniocentesis) or fetal tissue (choriocentesis). Non-invasive prenatal tests at an even earlier stage of pregnancy have now become available, including the analysis of fetal blood taken from women to identify the sex of the future child after the seventh week (Devaney et al., 2011). These tests are becoming increasingly affordable and self-sampling frees women from having to go to a laboratory.

Abortion following the prenatal sex diagnosis is the second component of this method. Access to abortion varies considerably from one world region to

(14) Adoption practices in China and India illustrate variations in family norms between sub-castes or patrilineal clans (Bharadwaj, 2003; Zhang, 2006).

the next. Abortion is forbidden in a number of countries, including for rape victims, while in others it is authorized as late as the second trimester. In countries where it is legal, abortion can generally be performed up to the end of the first trimester, enabling women to have abortions immediately after a prenatal sex diagnosis. In some countries, such as China, abortion is even authorized up to the 28<sup>th</sup> week of pregnancy. Sex-selective abortion may also be practiced in countries where it is officially outlawed, including Pakistan. The liberalization of abortion is leading to a rise in prenatal discrimination, as demonstrated in Albania, Nepal and Taiwan. Medical abortion may also be used by women for sex-selective purposes, and recent norms do not forbid the use of this form of abortion when the sex of the fetus becomes visible on an ultrasound scan (WHO, 2012). But as women using this method do not always consult a physician or attend a clinic (except for post-abortion complications), knowledge of the practice remains scant and its extent is still unknown, notably in eastern European countries where the practice of abortion is firmly rooted (Westoff, 2005).

The earliest method of prenatal discrimination today is pre-implantation genetic diagnosis. Since the 1980s, it has been possible to identify, among other characteristics, the sex of the embryo for in vitro fertilization, but also to select the embryo to be transferred to the future mother. The implanted embryo may be selected to avoid a sex-linked genetic disease, but in theory it is entirely possible to let parents choose the sex of their future child. Another sex selection method – older but less effective – involves the selective sorting of male sperm before insemination (known as the Ericsson method).

## II. The situation today

Our analysis covers all the countries and groups affected by the growing sex ratio at birth in the last 40 years. The SRB figures available for America and Western Europe are very close to 105 male births per 100 female births. For the sake of comparison, in Table 1 we have included figures from different countries, from Brazil to Japan, confirming the absence of suspicious fluctuations in the SRB in a large part of the world. The trends of the last 50 years, which are not included in the table, are imperceptible in these regions, since the annual SRB has rarely risen above 106. Annual variations, and even trends lasting several decades, do occur, but they are very small (Grech et al., 2003) and, unlike prenatal sex selection, have no notable demographic consequences. We will therefore focus on populations where the SRB appears to be skewed by discriminatory behaviour. Wherever possible, the figures used here are drawn from the national vital statistics. For some countries, we have used an alternative source of estimates based on what appear to be the most reliable

surveys. Where the estimates show annual fluctuations, particularly owing to the low number of births, the figures are aggregated over several years.<sup>(15)</sup>

## 1. East and Southeast Asia

China emerged at an early stage as the country with the most severe imbalances in the SRB.<sup>(16)</sup> It began to rise steadily from 1980, as shown by the annual series estimated by the National Bureau of Statistics of China, increasing in linear fashion until 1998 at a rate of nearly eight percentage points per decade. The increase was concurrent with and identical to that observed in South Korea for over ten years, but continued at the same pace in China after 1990 while dipping in South Korea. The annual estimates are shown in [Figure 2](#).<sup>(17)</sup>

Since 2000, the SRB has hovered around 120 male births per 100 female births at national level, but with major variations between provinces and ethnic groups. In a set of provinces ranging from Henan in the north to Hainan Island in the south, the ratio exceeded 125 in 2010. This is the highest SRB recorded in the world. However, it has trended downwards in the last few years and the estimated ratio in China in 2014 (115.9) was the lowest in over 15 years. It is still too early to forecast a lasting reversal in the masculinization of births, as the official estimates still need to be confirmed by another source.

The actual figure for the sex ratio of births in China is a statistic to be approached with as much caution as that concerning fertility, and the sources do not concur. There are significant differences between the figures of the complete 2010 census and those of its 10% sample, but also with respect to other sources.<sup>(18)</sup> The recent decrease could be largely artificial, corresponding to a deliberately optimistic government stance. In contrast, some specialists think that the share of male births is overestimated (Goodkind, 2011) and the UN Population Division puts the SRB at 116 for the 2000s (United Nations, 2013a).<sup>(19)</sup>

(15) The United Nations Population Division is gradually correcting its five-year estimates of the sex ratio at birth, which for many years were determined arbitrarily (United Nations, 2013a). We do not use these estimates, preferring wherever possible the original data.

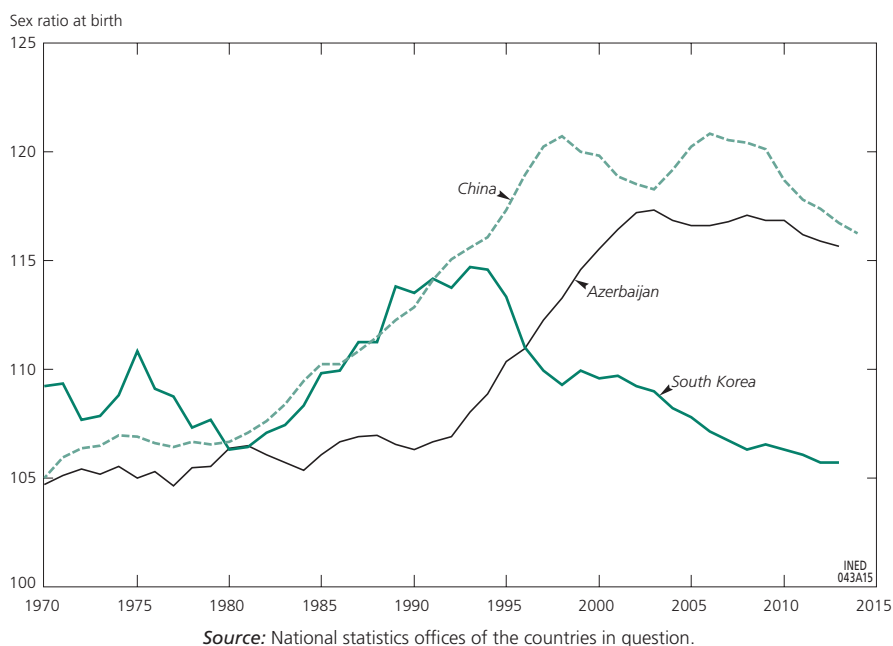
(16) For China, see notably the pioneering work of Gu and Roy (1995), Hull (1990), and for the recent period Attané (2013), Banister (2004) and Chu (2003). Cai (2014) proposes a systematic analysis of the data from the 2010 census.

(17) In Figure 2 we chose to focus on these three countries because of their distinctive profile and the quality of the annual data. Data for other countries, including India, Albania, Kosovo and Georgia are less reliable. Nevertheless, see Guilmoto and Duthé (2013) for Eastern Europe, GSO (2011) for Vietnam, and the multi-year estimates of the Sample Registration Survey for India. Annual series are also available from the statistical offices of Montenegro, Hong Kong, Taiwan and Singapore.

(18) The sex ratio among infants below age one was 118.9 boys per 100 girls in the 2010 census but 121.2 for infants born in the previous 12 months according to the 10% sample. The latter being of considerable size, no random variation can explain the difference between these two figures. The ratio was 118.6 on average in 2009 and 2011 according to the annual official estimate. The statistical office also estimated the sex ratio at 118.5 for the population aged under 5 in the 2012 demographic survey, which, given today's excess female mortality in China, corresponds to a SRB of nearly 118 for 2007-2012.

(19) The US census office, for its part, estimated the sex ratio of infants below age one at 114.5 in 2010.

Figure 2. Sex ratio at birth from 1970 to 2014 in Azerbaijan, China and South Korea (data smoothed over three years)



As demonstrated by the figures in Table 1, abnormal levels can also be seen in other countries with Chinese populations, starting with Taiwan, whose SRB is currently above the natural level (Lin et al., 2008). High SRBs can also be observed in Singapore and Hong Kong (Graham, 2007; Wong et al., 2010), as well as in Malaysia, where the Chinese-origin population shows a higher than average proportion of male births (Chua, 2014). Yet in none of these territories has the SRB consistently exceeded 110.<sup>(20)</sup> The case of more recent diasporas outside Asia will be discussed later.

The SRB has also risen in Vietnam. Since this country shares many socioeconomic, cultural and political traits with China, it has been monitored closely by researchers (Bélanger et al., 2003). Yet the increase only began in 2005, despite long-standing traditions that favour prenatal discrimination such as son preference and a decline in fertility. This lag is attributed mainly to the late introduction of new reproductive technologies (Guilmoto et al., 2009; GSO, 2011). But the ratio has increased swiftly, from 106 in 2005 to 112 in 2013-2014 according to the recent inter-census survey of 2014. The Vietnamese government has responded earlier than other countries to the problem of prenatal sex discrimination.

(20) But the SRB in Hong Kong was 114 in 2014, including children born to women from the continent who came there to give birth.



The most singular trend is to be found in South Korea.<sup>(21)</sup> After a period of questionable estimates, the ratio increased, as in China, from the early 1980s. It peaked in 1990 (at 116) in the Year of the Dragon, an auspicious year for boys (Lee and Palk, 2006). It then stabilized at around 115 for a few years instead of continuing to rise as it did in China, before initiating a record fall after 1995. This turnaround was followed by a regular decrease in the SRB in the ensuing years. In the last few years, the sex ratio at birth has been close to the normal level, at 106 male births per 100 female births. It seems unlikely that the ratio will rise again in the future. This return to normalcy coincided with the strengthening of government policies targeting prenatal sex discrimination. But it also coincided with a period of spectacular economic growth for South Korea – referred to as “compressed modernity” by the sociologist Chang Kyung-Sup – which came to an end with the 1997 financial crisis. During this period, the condition of women improved considerably in terms of education, employment and legal status, finally undermining the foundations of traditional Confucian society (Chung and Das Gupta, 2007).

## 2. South Asia

The demographic weight of South Asia is considerable. The region is dominated by India, where skewed sex ratios have long been a source of debate owing to the female infanticide observed during the colonial period, notably in the northwest (Miller, 2007). The effects of new technologies on discriminatory behaviour was documented from the late 1970s (Ramanamma and Bambawale, 1980), but the imbalances were not confirmed by statistics until nearly 20 years later (Arnold et al., 2002; Bhat, 2002; John, 2014). Old annual series are not available, but estimates based on the census and samples drawn from civil registration suggest that at national level the SRB has risen more slowly in India than elsewhere, having stabilized at 110 male births per 100 female births in the last ten years.

National trends are changing slowly because they are the composite product of often divergent regional trends. The ratio in India ranges between normal levels in numerous regions, notably in the south and east, and extremely high levels, close to 120, in the northwest (Arokiasamy, 2004; Jha et al., 2011; Sudha and Rajan, 1999). It is in this part of the country (Punjab, Haryana and Delhi) that the rise was both earliest and strongest.

The overall stabilization of the SRB in India since 2001 conceals rising levels in some regions and falling levels in others. From 2001, the SRB began to trend downwards in the northwest after reaching extreme levels (Diamond-Smith and Bishai, 2015). Elsewhere in the country, and particularly in the large central and northern states, the ratio has risen to a worrying extent. In contrast with China, birth control policies in India have been implemented on a mainly

(21) For more information on South Korea, see Kim and Song (2007), Park and Cho (1995). Schwekendiek (2010) observes that, in contrast, North Korea appears to have a normal SRB.



voluntary basis since the failure of authoritarian measures introduced in 1975, while economic growth came later and more slowly. The federal government launched its first policy to combat prenatal discrimination in 1994 following an initial ban in Maharashtra State in 1988.

Elsewhere in Asia the situation is more complex. Some countries, including Sri Lanka, appear to be immune to prenatal discrimination, and the same is undoubtedly true for Bangladesh, despite the preference for boys (Kabeer et al., 2013). In contrast, Nepal was the last country in the world to experience a rising proportion of male births, several years after the legalization of abortion in 2002 (Valente, 2014). According to the 2011 census, the trend is particularly evident in the country's wealthiest valleys. Owing to a lack of recent census data or data series from civil registration, the situation in Pakistan is among the least well understood in the region despite the country's demographic importance. The ratio is estimated at 109, purely on the basis of demographic and health surveys, but the strong preference for boys has been confirmed (Hussain et al., 2000). Knowledge is even patchier concerning Afghanistan, where attitudes towards women also provide a favourable terrain for prenatal discrimination.<sup>(22)</sup>

### 3. Eastern Europe and diasporas

In Eastern Europe, here extended to include the former republics of the USSR, the masculinization of births came to light only recently. It is true that the countries in question have lower populations and annual figures are subject to a range of random variations, as demonstrated by the figures for Montenegro. Moreover, the relatively reliable statistical system of the socialist period was impacted by the successive political and economic shockwaves that hit the region (economic crisis, withdrawal of the state, military conflict and civil war). So it was only at the end of the last decade that a rise in the SRB was confirmed. A report by the European Council provided a first ever panorama of the situation, prompting the countries in the region to initiate national assessments (Guilmoto and Duthé, 2013; Stump, 2011).

The first region with a surplus of male births comprises the three countries of the Southern Caucasus: Azerbaijan, Armenia and Georgia (Duthé et al., 2012; UNFPA, 2013a; UNFPA, 2014). The SRB began to rise immediately after independence in 1991, as suggested by data series drawn from civil registration. The data for Azerbaijan shown in Figure 2 clearly sum up the trends in the three countries. The increase appears to have been comparable with that in China but began a decade later following the dismantling of the Soviet Union. The SRB rose continuously over a 12-year period until reaching nearly 117 in around 2003. Azerbaijan today rivals China as the country with the world's

(22) The 2010 mortality survey, partly comparable to a Demographic and Health Survey, showed a pronounced surplus of male births. The sex ratio at birth was 115 for the 53,000 births reported for the decade preceding the survey.

highest SRB. The highest SRB level – also reached in Georgia and Armenia after 2000 – is closer to 114.

The rise in the SRB in the Caucasus appears to reflect the effects of regime change that were liberating but at the same time catastrophic. The trend played out against a backdrop of economic and political crisis and territorial conflict, accompanied by a drop in fertility and increased reliance on the family unit. Meanwhile, new medical equipment, ultrasound in particular, arrived as the countries opened up to foreign trade. The SRB has stabilized today at different levels by country. Prenatal sex selection is most frequent in Azerbaijan, despite a slight rise in fertility, while the most recent data from Georgia show a substantial decrease. These three countries – plus the small and disputed territory of Nagorno-Karabakh where the SRB is also strongly skewed, with an SRB of 115.4 for 2005-2012 – are marked by strong ethnic, religious and linguistic differences. But they form a compact ensemble that stands clearly apart from the three bordering countries of Iran, Turkey and the Russian Federation, where no significant masculinization of births has ever been observed (Meslé et al., 2007).

A second notable area with high sex ratios at birth is emerging in the western Balkans around Albania. It also includes Kosovo, Montenegro and the western part of the Republic of Macedonia, all three having belonged to the former Yugoslavia. The increase began in 1995 in post-socialist Albania, several years after the Caucasus. The slight lag can be attributed to the delayed legalization of abortion, which occurred only in 1995. The masculinization of births in the western Balkans is more moderate than elsewhere but the SRB nevertheless stands at 110. This more modest imbalance explains in part why the increase was observed at a later stage (Guilmoto, 2010b) and why documented studies, combining field surveys and statistical analysis, exist only for Albania (UNFPA, 2012b). These countries all exited the socialist system in the 1990s but took different paths, ranging from near peaceful transition in Montenegro to bouts of civil war in Albania and periods of armed insurrection in Kosovo and Macedonia. Apart from Montenegro, where Albanians account only for a small minority of the population, all the regions in question are part of the Albanian settlement area in southeast Europe, suggesting a strong ethnic component to discriminatory practices based on Balkan kinship structures and gender systems, as described by Denich (1974).

In the rest of the world, there are no concrete traces of a distorted sex ratio at birth at national level, although some isolated cases, such as the high estimated ratios in Afghanistan and Tunisia, are worthy of attention.<sup>(23)</sup> Some

(23) The 2015 DHS survey should provide additional sources for Afghanistan. The SRB in Tunisia has stood at around 108 since 1991 according to vital statistics, and the 2010-2011 figures show ratio of 110 in the Tunis Governorate. No data are available for the period after 2011 and the age distribution of the 2014 census is not yet available. Abortion has been legal since 1973 in Tunisia, unlike in the other countries of the Arab world (excluding Bahrain) where it is severely limited, and Tunisian fertility is the lowest in the region.

countries, particularly in the Near East and sub-Saharan Africa, also stand out, since demand for sex-selective practices is already becoming visible (Yout, 2001; Memmi and Desgrées du Lou, 2014). Abortion is illegal in these countries and as a result some observers see the unmet demand for boys as an explanation for the level of fertility, which remains higher than elsewhere (Courbage and Todd, 2007). Our interpretative framework presented below suggests that these patrilineal countries show strong potential for the future emergence of prenatal sex selection.

Populations of immigrant origin have been studied in rich countries since the pioneering article by Dubuc and Coleman (2007) highlighting the masculinization of births among Indians in the United Kingdom. Based on figures concerning the United States, Canada, Australia, Norway, Italy, Greece and Spain,<sup>(24)</sup> it has also been shown that Asian and Albanian diasporas practice sex selection, particularly after successive births of girls. Some countries with large migrant populations, such as France, Germany and the Netherlands, have yet to be studied as ethnic data are not available. Although the distortion of the SRB in these diaspora populations remains modest relative to that observed in the origin countries, and has no impact on the national population as a whole, it does show that the socio-political conditions in the origin country do not fully explain the discriminatory behaviour and that the economic mobility resulting from the move to a richer country does not undermine migrants' long-established cultural values.

### III. Variations in the sex ratio at birth within countries

The sex ratio at birth varies considerably within countries affected by prenatal discrimination. The disparities observed affect all social groups, and statistical analysis of these variations can generate a picture that is relatively complicated to interpret (Bhat and Zavier, 2007). But examining these variations is worthwhile for several reasons, both to decipher the social and demographic characteristics behind the discriminatory behaviour and to better target the populations liable to practice sex selection.

#### 1. Birth order and sex composition of siblings

The SRB tends to increase with birth order, and prenatal discrimination for first births is generally infrequent. Parents leave the sex of their first or second child up to chance, but then practice prenatal sex selection to adjust the sex composition of their offspring, notably using sex-selective abortion to prevent an unwanted birth (in general, female). From a demographic point of view, the fertility strategies employed are relatively complex. Prenatal sex

(24) See Almond et al. (2009), Egan et al. (2011), Gonzales (2014), Meldolesi (2011), Singh et al. (2010), and Verropolou and Tsimbos (2010).

selection is only one tool, combined with the decision to stop having children based on the sex of the children already born. Many couples use contraception after a male birth without resorting to prenatal sex selection, while still others have more children to achieve the desired numbers of sons.

The most visible sign of these practices is a normal sex ratio for first births followed by an often sharp rise for later ones (Bhalotra and Cochrane, 2010; Jayaraman et al., 2009). Evidencing these artificial differences between birth orders also serves to refute the assumption of a biologically higher proportion of male births in certain populations that is sometimes put forward to explain skewed SRBs. The distortion in the SRB occurs from the second or third child, depending on mean fertility in the country concerned. Table 3 gives estimates from different countries.<sup>(25)</sup>

**Table 3. Sex ratio at birth by parity in different countries**

	1 <sup>st</sup> birth	2 <sup>nd</sup> birth	3 <sup>rd</sup> and higher birth
Armenia (2008-2012)	106.5	110.5	162.4
China (2010)	113.7	130.3	158.4
South Korea (2012)	105.3	104.9	109.2
Georgia (2006-2012)	108.3	108.9	130.5
Taiwan (2012)	106.8	107.1	112.4
Vietnam (2009)	110.2	109.0	115.5

*Note:* The figures available for India are too unreliable to be presented here.  
*Sources:* Armenia, South Korea, Georgia: national statistics offices; China: census (2010); Vietnam: GSO (2011).

The table shows that in China, where fertility is lower owing to drastic family planning regulations, the sudden jump occurs from the second child, for which the SRB rises to 130. Elsewhere, including in India and Eastern Europe, it is only after two children that some parents resort to prenatal sex selection to avoid having children of an unwanted sex. This is true in Armenia and Georgia, where the SRB increases from the third birth, rising to a record 162 for the third and subsequent births. These extreme figures suggest that parents have a third child primarily to obtain a son and are determined to avoid the birth of another girl. In South Korea, traces of the discriminatory system in existence before 2000 are still visible, with a slight rise in the sex ratio for third and higher order births.

Wherever possible, it is by calculating the sex ratio via the sex composition of siblings that the most accurate measures of selective choices are obtained.<sup>(26)</sup> Successive female births have an extreme effect on the sex ratio of the following

(25) Many countries do not publish figures of sex ratios by parity. Often the only information available consists of fragile estimates based on small samples for later parities.

(26) These detailed figures are generally not available, or only on the basis of fertility surveys covering a small number of births. Such reconstitutions can only be made on the basis of census samples. See, for example, GSO (2011) for Vietnam and UNFPA (2012a) for Albania.

births. The calculations established on the basis of the 2001 census in Armenia show that the ratio of male births rises to over 220 following the birth of two girls, and to over 300 after three girls (UNFPA, 2013a). These extreme figures suggest that the additional birth is intended purely to produce a son. The sex ratio after several sons remains normal, however. In theory, the birth of boys may encourage sex-selective behaviour favouring the birth of a girl, especially in matrilineal societies, but no examples have yet substantiated this hypothesis.

Several figures in Table 3 point to an increase in sex selection at lower parities. The SRB for first births rises to suspicious levels in several of the countries under consideration. This is particularly true for Vietnam, where the ratio is even higher for first than for second births. The situation in China has worsened recently, with a sex ratio of first births of 114 according to the 2010 census. Many couples who may not have a second child want to make sure that their first one is a boy.

A structural trend such as this is worrying for the future, because the increase in the SRB for first births has considerable impact on the mean SRB for all births. First births are the most numerous and can account for nearly half of all births when mean fertility falls below two children per woman. In the case of China in 2010, prenatal discrimination for first births accounted for 35% of the overall deficit in female births – if we take 105 as a natural sex ratio at birth. And in the major Chinese cities alone, first births are responsible for exactly half of the total national imbalance. All of which shows the extent to which the Chinese now refuse to leave such matters to chance and to negotiations with the family planning authorities, preferring instead to make sure their first child is a boy. The example of China is extreme, but a skewed ratio in the sex ratio of first births is also evident in Vietnam and can now be seen in the Caucasus countries such as Armenia and Georgia.

## 2. Regional and urban/rural disparities

Geographical variations are generally quite considerable within countries affected by SRB imbalances. According to the Indian census of 2011, the SRB for the population aged under 7 is above 120 in 29 districts (out of 640), while the levels for the vast majority of the rest of the country, from Kerala to Western Bengal, are practically normal (Guilmoto, 2008). The situation in China is less contrasted, but Anhui Province stood out in 2010 with a ratio of 131 (and 168 for second births). The ratio in Guangdong, the country's richest province, is almost as high, at 129. In contrast, the figures are normal for the less populated and less wealthy provinces with larger ethnic populations such as Xinjiang, Inner Mongolia and the Tibet Autonomous Region – the only areas with values below 110 (Cai and Lavelly, 2007). Similarly, the highest SRBs in Vietnam are concentrated in the Red River Valley, the region most heavily impacted by the historical influence of Confucian culture (GSO, 2011), and the increase observed in 2011 in Nepal is visible only in the Kathmandu Valley, the cradle of Nepalese

Hinduism (Puri and Tamang, 2015). Research has also demonstrated significant regional differences in Albania, Armenia and Korea (Kim, 2008a).<sup>(27)</sup>

Spatial concentration is a specific trait of skewed sex ratios at birth. It reflects a heterogeneous population and, in particular, a diverse ethnic composition, a point examined later in this section. Inter-regional variations in SRB are much more pronounced than those affecting other demographic aspects such as fertility or mortality, because traditional social institutions, notably governing gender relations, have proved more resilient to social change than health or fertility behaviours.<sup>(28)</sup> But the concentration also reflects the gradual dissemination of sex selection throughout the country, starting in pioneer areas where the introduction of prenatal diagnosis technologies and the decrease in fertility occurred earlier than elsewhere.

Differences between urban and rural areas are a more complex issue. Cities are characterized by a number of factors liable to favour prenatal sex selection, including a dense healthcare infrastructure, the relative prosperity of city dwellers able to pay for access to modern technologies, an earlier fertility decline, and stricter supervision by family planning authorities. These factors tend to explain why the proportion of boys increased first in urban areas and has often remained higher there than in rural areas, as is the case in India (Arokiasamy, 2004). The specific impact of cultural attitudes favouring boys is more ambiguous. Son preference is likely to be more pronounced in rural areas owing to the greater importance of traditional family norms, but also to the central role of men in the rural economy, where they take precedence over women in managing crops and livestock. In cities, women's increasing access to education and financial autonomy is eroding these old values, and laws prohibiting sex discrimination, for example in the transmission of property, are more frequently enforced. China thus provides an example of a country where the sex ratio at birth remains higher in rural areas (Lei and Pals, 2011), even if the difference remains modest (118 in large cities and 122 in the countryside in 2010).

### 3. Ethnic and religious disparities

Data on demographic masculinity are often analysed by cultural group, notably through age-sex distributions by ethnicity and religion. Differences between ethnic groups are highly pronounced and often explain a large part of the regional disparities mentioned above. In China, SRBs are more skewed among the majority Han group and among the sinicized Zhuang and Miao minorities, while other ethnic groups such as the Tibetans and Uyghurs are much less affected. Similarly, the majority Kinh group in Vietnam has a higher proportion of male births than the Khmers or the ethnic groups in the Central

(27) UNFPA (2012a) reproduces several maps of regional differences.

(28) See <http://iussp2005.princeton.edu/abstracts/51529>.

Highlands, while in Georgia, the Azeri populations have higher SRBs than the rest of the population. In India, the Punjabis are strong practitioners of prenatal sex selection, in contrast with the Bengali and Telugu populations. But the segmentation of populations does not lead to a geographical mosaic in the distribution of skewed SRBs at national level. In most countries, variations in surplus male births appear to follow broad regional gradients, as in the north-south divide in Vietnam, the west-east divide in Georgia, the northwest-southeast divide in India and the west-east divide in China.

Differences between religions are sometimes observed. Christians in South Korea and Muslims in India practice prenatal sex selection less than the rest of the population (Kim and Song, 2007; Guilimoto, 2008). Some populations tend to avoid abortion on religious grounds. But the connection between religion and the proportion of male births remains relatively unclear. Skewed SRBs are found in regions that are traditionally Hindu (India, Nepal), Muslim (Albania, Azerbaijan), Buddhist (South Korea, Taiwan, Vietnam), Christian (Armenia, Georgia, Montenegro) or secular (China, Vietnam, Eastern Europe). Yet practically no increase in SRBs has been observed in neighbouring Buddhist countries (Thailand, Sri Lanka), Muslim countries (Iran, Indonesia), or Christian and secular countries (Philippines, Southeast Europe, Russia), and the same is true in a large number of Hindu-majority states in India (Andhra Pradesh, Bihar, Odisha). The Sikhs in India may constitute a special case, with very high sex ratios (127 for under-sevens in 2001) concentrated in the States of Punjab, Haryana and Delhi. But it should be noted that all the other religious groups, from Hindus to Muslims, also show higher SRBs in this part of India than in the rest of the country. The spatial effect, notably connected to local family institutions, is combined here with religious factors.

#### 4. Socioeconomic disparities

Variations in the proportion of male births between social categories have been studied less fully than variations between religious or ethnic groups owing to a lack of directly usable data from censuses or civil registration. Contrary to expectation, the share of male births is higher among the wealthiest and most educated populations, while the most disadvantaged often have sex ratios close to normal (Siddhanta et al., 2003). These differences are not hard to understand if we keep in mind that sex-selective abortion is conditional upon low fertility and easy access to new technologies – two variables associated with high socioeconomic status. Higher social categories have fewer children, are better informed about existing prenatal sex selection methods, and have higher incomes. But the positive relationship between (female) education and sex-selective practices is a delicate one, since it suggests that the universally encouraged progress in female education tends to foster prenatal sex selection rather than fight against it. In the counterexample of South Korea, it is only



after reaching a high level of development that the country saw a decline in prenatal sex selection.

In theory, son preference should nonetheless decrease among the wealthiest strata of the population as women achieve greater independence from the traditional family system. Various studies point out that the positive relationship between household income and prenatal discrimination can be reversed above a certain social level, with son preference falling among the wealthiest and most educated quintile (Cai, 2014; Echávarri and Ezcurra, 2010; Guilмото and Ren, 2011). This work suggests a non-linear relationship, in the form of an inverted U, between family socioeconomic status and the propensity for prenatal sex selection. Demographic masculinity may thus gradually enter a top-down mechanism of transition whereby the proportion of male births begins to increase in privileged social groups and then gradually across society as a whole. The SRB should finally return to normal after many years, a process starting once again with the higher social classes, as observed in South Korea (Chun et al., 2009). These observations underscore the relevance of a socioeconomic approach to the SRB as a means to foresee trend reversals and, in the long term, a gradual return to normal levels.

#### IV. Understanding skewed sex ratios at birth

In each national context, acknowledgement of the existence of prenatal discrimination has led to the emergence of explanations that continue to structure current debate on the rise in sex ratios at birth. Controversy in China concerns the respective responsibility of the one-child policy and the persistence of ancestral “superstitions” informed in particular by Confucianism. In India, the master narrative has highlighted increasing dowry practice and dowry inflation<sup>(29)</sup> across the country over the last 30 years as households have become wealthier. In Eastern Europe, to the extent that the issue has truly assumed importance in today’s civil society, the emphasis is on the worsening economic and political situation stemming from the exit from socialism and on the growing need for men, for reasons of both migration and strategic defence to guard against the risk of conflict.

A comparison of these various contextual interpretations quickly reveals their relative incompatibility. After all, China is the only country to have implemented a highly rigorous birth control policy, yet Chinese people outside China also practice prenatal sex selection. Dowries are specific to India and marital payments elsewhere are often informed by diametrically opposite principles. In China, for example, it is the young husband who generally makes

(29) The dowry, paid by the bride’s family to that of the husband, is worth the equivalent of several years of income and is a form of early inheritance for girls. Some think that the dowry is as much the result of skewed SRBs as the original cause (Bhat and Halli, 1999).



the biggest contribution to the assets of the future household (Jiang and Sánchez-Barricarte, 2012). The theory of economic crisis and conflicts applies almost exclusively to Eastern Europe as Asian countries have experienced a period of near uninterrupted growth. Compounded by the lack of comparative studies, each national context produces its own discursive approach,<sup>(30)</sup> and a global explanation is yet to emerge.

## 1. A global interpretative framework

The simultaneous increases in sex ratios observed in the last 30 years and the obvious similarities between them call for a global approach to what are mainly locally observed phenomena. From a strictly demographic standpoint, the countries share many of the same characteristics, from the role of sex-selective abortion to variations in SRBs by birth order and the uneven dissemination of prenatal sex selection practices across local society. But several contextual components can be observed in all the countries affected by the phenomenon, be they related to demographic trends (a decrease in fertility), health (the rapid modernization of healthcare infrastructure and the emergence of new reproductive technologies), politics and economics (economic liberalization, privatization, withdrawal of the state) or culture (“patriarchal” institutions, central role played by families in social arrangements). Some analyses have favoured one or other of these aspects, for example stressing the controversial role of healthcare services, family planning objectives or economic liberalization in the increase in male births, as in the widely read work by Hvistendahl (2012).

In reviewing the causes of this increase in the proportion of male births, we will rely on a unique interpretative framework derived from the preconditions of fertility decline established by Ansley Coale.<sup>(31)</sup> Three orders of intermediate factors act as preliminary conditions for prenatal sex selection: those concerning supply and the ability to take action, those concerning demand and preference, and thirdly, the impact of demographic pressure (Guilmoto, 2009). The first condition corresponds to sex selection technologies, including abortion. This is the supply factor, which assumes that couples who so desire *are able* practice prenatal sex selection. The second condition assumes that some families *want* to actively favour or avoid births of either daughters or sons. This is the demand factor, which can be explained only in reference to existing gender relations. The last condition reflects the mechanical effect of the decrease in fertility on

(30) Some purely formal approaches look for exogenous and non-demographic determinants of the SRB. The most imaginative and widely cited example is undoubtedly the econometric study connecting the rise in the SRB to the fall in the price of tea in China (Qian, 2008). The mechanism supposedly works as follows: the fall in the tea price primarily affects a sector dominated by female workers and thereby serves to increase son preference in the short term.

(31) According to Coale (1973), in order for fertility to decrease, it must enter the realm of conscious choice, lower fertility must have perceived advantages, and effective birth control techniques must be available. These three conditions (ready, willing and able) were reformulated by Lesthaeghe and Vanderhoeft (2001), whom we draw upon here.

the risk that couples may end up not having a boy, meaning that couples *must* practice prenatal sex selection if they want to have the desired number of sons and daughters.

Each of these three factors constitutes a necessary condition for the masculinization of births. They also serve as intermediate variables of prenatal sex selection that are affected by variables specific to each context, such as dowries (on the demand side), birth control policies (on the fertility side), imports of modern ultrasound equipment or the legalization of abortion (on the supply side). More complex relationships also exist between the three factors,<sup>(32)</sup> but we will address them independently here for the sake of clarity.

## 2. Demand for sons

The central cause of the rise in the sex ratio at birth is naturally connected to son preference. This was the focus of the earliest research in this area, because data from the 1970s fertility surveys and onwards suggested that reproductive behaviours could be conditioned by the number of children already born and the sex composition of offspring. A range of different studies, both demographic and anthropological, produced extensive comparative analyses of gender preferences (Cleland et al., 1983; Williamson, 1976). In the developed world, these preferences have only a slight impact, as illustrated by cases in the United States and Europe (Hank and Kohler, 2000; Raley and Bianchi, 2006). In parallel, the first field studies, notably in South Asia, very quickly demonstrated the effects of discrimination against girls on mortality and infanticide (Croll, 2000; Miller, 1981).

Over the years, studies have described in greater detail the many social practices honouring male births, involving numerous rites aimed at facilitating and then celebrating the arrival of sons. The birth of daughters, on the other hand, is a sign of bad luck or even a source of dishonour for the mothers and the family. This son preference takes a range of forms in different anthropological contexts and family systems (Bélanger, 2002; Croll, 2000; John et al., 2008; Skinner, 1997; UNFPA, 2011). In most cases it is formally sanctioned by written or religious traditions, such as the Laws of Manu in South Asia, the *Kanun* in the Albanian region, and Confucian tenets in East Asia. It is also justified by funerary practices or the cult of ancestors that remains the prerogative of sons in many parts of Asia. The prestige of male children has also withstood decades of forced secularization stemming from communist systems, as seen in Albania and Vietnam.

A more materialistic approach has also highlighted the advantageous economic and social role of boys for families, notably linked to their function

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(32) For example, son preference and Malthusian pressure tend to stimulate the supply of sex selection tools as a response to a formerly unmet need to choose the sex of one's offspring. Conversely, new prenatal sex selection technologies have facilitated the fertility decline by enabling couples to terminate unwanted pregnancies.

in the extended household as producers in the family economy also responsible for the security of the household and for supporting their elders. These roles are intimately linked to marriage rules and residential arrangements, and patrilocal practices in particular. On a broader scale, the role of men in the defence of the community – be it village, clan or caste – or that of society as a whole appears to be a crucial trait, especially in countries where social groups are often in conflict. The role of boys is particularly important where state or market institutions – such as the police, insurance and pension systems and the protection of property rights – are weak. The social, economic and protective functions of boys are closely connected to social prestige and religious precepts, though it is not always possible to disentangle the role of pragmatic interests from that of inherited habitus (“ancestral mentalities”) in the devaluation of women. Demographic and health surveys, along with census data, are an invaluable source of information for understanding gender prejudices and have brought to light a vast number of traits correlated to preference for boys (Li and Lavelly, 2003; Pande and Astone, 2007).

Other work has attempted to highlight departures from the traditional model of gender inequality. Research on China has shown how recent social, political and economic change, such as the agricultural reforms of the 1980s that favoured men (Eklund, 2011; Murphy et al., 2011), may have aggravated some aspects of son preference. But these changes can also serve to weaken inherited gender bias (Kim and Fong, 2014; Vlassoff, 2012; Zhou et al., 2012). This is a key issue because the emergence of new family norms that are more egalitarian in the treatment of girls and boys will inevitably lead to a reduction in prenatal discrimination.

Measuring this preference for male children is fundamental to demographic research. While extensive qualitative work has focused on describing gender inequalities in their context, it cannot provide a measure of the relative intensity of son preference, which would, for instance, permit a comparison between regions and between social groups. Demographers employ a range of methods to estimate these preferences. The first such methods are based on the ideal sex composition of the family as reported by parents. Fuse (2010) compiled DHS data to this end and showed that boys come first in numerous countries. But it is not certain whether this declarative measure is always appropriate. Parents wanting two children naturally say they want a boy and a girl, in appearance quelling any notion of gender bias. But in a context of discrimination against girls, the absolute rule consists in fact in avoiding two daughters at all costs.<sup>(33)</sup> The opinions recorded in surveys may also be artificially distorted by the pressure of gender equality campaigns or by *ex post* rationalizations (Bongaarts, 2013). It is more useful to measure the desire for another child or contraceptive practices according to the sex composition of preceding children.

(33) Bhalotra and Cochrane (2010) also show that in India the ideal family composition is closer to two boys and one girls than one of each.

But these indicators by parity and sex composition of offspring are based on even smaller samples and cannot easily be cross-linked with other geographical or socioeconomic indicators.

Rather than holding exclusively to opinions expressed in surveys, which do not fully reflect real intentions or subsequent behaviour, measuring actual fertility behaviour provides more robust indicators of revealed preferences. In societies practicing birth control, for example, the sex ratio of the last birth has been used to detect the existence of preferences, since the decision to have no further children is the product of the expectations and desires of parents in terms of sex composition. It is also possible to measure fertility behaviour based on the expected sex composition by using parity progression ratios.<sup>(34)</sup> There are often more births in sibships without boys than in others, as shown by the data from the DHS surveys (Filmer et al., 2009). After reconstituting families using the own-children method, these methods can be applied on larger samples drawn from censuses (Guilmoto, 2012b).

To conclude, we still need to address a question that numerous contextual studies tend to overlook, namely the origins of gender inequality and discrimination against girls. To a considerable degree, sexism would appear to be based on local customs governing religious, familial and economic practices. The weight of traditional institutions such as castes, clans and extended families fails to fully answer the question since, once again, numerous rural societies, including in Asia, have no ingrained preference for a given sex. Son preference is most often determined by local cultural heritage and the reasoning may be circular (boys being preferred in order to satisfy tradition). But the prevailing view of discrimination against girls links these discriminatory practices to kinship systems (Das Gupta et al., 2003; Miller, 2001). A preference for boys is an integral component of the patrilineal kinship systems in which women join their husband's family line after marriage (Lavelly and Ren, 1992). The rules of patrilocal marriages and inter-generational cohabitation are characteristic of these systems, summarily referred to as "patriarchal" systems, which may encourage families to prefer sons (Greenhalgh, 2013).

In contrast, no prenatal discrimination is observed in the bilateral kinship societies of Southeast Asia and Western Europe.<sup>(35)</sup> This explains the sharp discontinuities between patrilineal southern China and Vietnam and their immediate neighbours Laos, Cambodia and Burma, characterized by bilateral kinship systems (Dube, 1997; Schenk-Sandbergen, 2012). In Eastern Europe, patrilineal family structures did not entirely disappear during the communist

(34) The parity progression ratio measures, for each birth order, the percentage of women who will go on to have another child. In countries with a preference for sons, this ratio is higher if there are no previous male births. See for example the case of Nepal in Leone et al. (2003), India in Roy and Chattopadhyay (2012) and Germany in the nineteenth century (Sandström and Vikström, 2015).

(35) A bilateral system, as in Western Europe, does not distinguish kinship by maternal or paternal side. Maps of kinship structures can be found in Müller (1999), with data drawn mainly from the famous atlas by Murdoch (1981). For Eurasia see Todd (2011) and Goody (1990).

period and they made a comeback with the political transition starting in the 1990s, following the collapse of state institutions and the failures of the market system that was supposed to substitute for those government bodies (Kaser, 2008). In some heterogeneously populated countries, such as Vietnam or India, it is even possible to make a direct connection between kinship system and skewed sex ratios at birth (Guilmoto, 2012b; Chakraborty and Kim, 2010). Recent research also explores the historical conditions behind the emergence of family systems (Todd, 2011) and gender inequalities, as well as possible links with farming production methods and even geological conditions (Alesina et al., 2011; Carranza, 2012; Grogan, 2013). But this anthropological approach mainly confirms that son preference results from a much broader system of norms governing family attitudes and practices in a given cultural context, while making no systematic links with other manifestations of sex discrimination.

### 3. Prenatal sex selection tools

Thanks to progress in reproductive technologies, the supply factor has played a crucial role in recent decades. Traditional methods have long been employed in an attempt to control the vagaries of biology. The most unreliable methods were based on ritual practices, such as pilgrimages and offerings, or manipulations of timing or diet affecting conception and pregnancy. A number of traditional techniques are still used today to influence or plan the sex of pregnancies (Bandyopadhyay and Singh, 2007; ISDS, 2007; Peng and Huang, 1999). Negligence and lack of healthcare remain a common way of eliminating children of the undesired sex, as reflected in the excess mortality of girls (Fuse and Creenshaw, 2006; United Nations, 1998, 2011).<sup>(36)</sup> But the most widespread method for obtaining a child of the right sex has long been to go through multiple pregnancies, at the cost of family size, as it takes two births on average to obtain a child of the desired sex. In the event of failure, intra-family adoption, particularly of a patrilateral nephew or a son-in-law considered henceforth as the family's son – once a frequent practice in China – was the final option for satisfying the demand for sons to continue the family line, (Wolf and Huang, 1980). Sex permutations are a possibility in some regions, with biological daughters treated socially as boys in response to the lack of a son. Traces of this practice can be found in the temporary pre-puberty transformation of the gender of *bacha posh* (girls “dressed as boys”) in Afghanistan and in the permanent conversion of “sworn virgins” (*virginesha*, *burrnesh* or *zavetovana devojka*) into men in Montenegro, Albania and Kosovo (Nordberg, 2014; Young, 2000).

Contraception was the first technological leap in sex-selective reproductive strategies because it can be used to avoid births once the desired family composition is achieved. This is reflected in the termination of childbearing

(36) The initially expected replacement of excess female mortality by prenatal sex selection has yet to occur (Goodkind, 1996).

following the birth of a boy, as seen in Vietnam (Pham et al., 2012). Bongaarts (2013) has focused on the concept of the sex ratio at the last birth, an indicator largely exceeding 105 in regions where families prefer boys to girls and illustrating the close link between sex preference and skewed sex ratio (even if the rules governing the end of childbearing after a male birth have absolutely no effect on the SRB, which continues to be determined by biological chance). The indicator can also be used to identify new world regions with a preference for male births – even when prenatal sex selection does not exist – and thus serve as a warning indicator.

The rise of modern prenatal sex selection in the 1970s made it possible to anticipate and, if so desired, avoid pregnancies of the undesired sex. For the first time in history, both the quantity (number) and quality (sex) of offspring, to use the terminology of Gary Becker (1981), could be controlled. Since bans were introduced on divulging the sex of the fetus (see below) – easier to implement in public establishments – very little work has described what happens in private clinics or in families when decisions on sex-selective abortions are taken. Some research has attempted to use the dissemination of ultrasound equipment as an indirect indicator of increased supply at local and national level (Chen et al., 2011; Gammeltoft and Nguyen, 2007), but most prenatal examinations and abortions are still carried out for reasons quite unrelated to sex-selective strategies.

We mentioned earlier that technological progress leads to increasingly early sex selection, especially when carried out *in vitro*, which is safer, more discreet and less complicated for women. This is the case with more recent prenatal sex selection technologies, from fetal blood tests to medical abortion and pre-implantation methods, for which very few data exist.<sup>(37)</sup> The ethical questions raised by these technologies are already being debated in Europe and elsewhere (Allyse et al., 2015; Dondorp et al., 2013). Yet these are the embryonic sex determination techniques of the future, since progress in preimplantation genetic diagnosis (PGD) has made it an alternative to prenatal diagnosis followed, if necessary, by induced abortion. And while these techniques are very expensive today, they will soon become more affordable. These forms of PGD sexing are strictly regulated in Europe, but other countries such as Thailand and the United States allow parents using *in vitro* fertilization to choose the sex of their embryo, thereby encouraging reproductive tourism (Whittaker, 2009). The use of these methods and their incidence on the population has so far been limited by their cost and by restrictive legislation.

#### 4. The decline in fertility

The final factor behind the rise in prenatal sex selection results from the specific impact of fertility decline on sex-selective practices. This decline has

(37) The few statistics that do exist, from Taiwan, confirm that the use of assisted reproductive technologies favours male births (Directorate-General of Budget, 2011).

a mechanical consequence since the risk of not having a child of a given sex increases when the average number of children falls. Affecting just 6% of couples with an average of four children, this risk rises rapidly to 24% for those with only two and 34% for those with 1.5. Low fertility, then, is a factor of constraint, referred to in the literature as a “squeeze” effect. When the marginal cost of a child increases, a Malthusian pressure is exerted on couples who gradually lose the flexibility to adjust their fertility to meet their need for sons or daughters.

This explains why the highly restrictive family planning policy in China has often been blamed for causing the rise in the sex ratio. The authoritarian birth control policy places extreme pressure on couples. But the reality is more complex, since for most of the rural Han population, families are allowed to have another child if the first is a girl.<sup>(38)</sup> This openly sexist provision, establishing official sex discrimination between births, was designed to make the one-child policy more tolerable. It led to an unprecedented rise in the sex ratio among second births. Meanwhile, fertility in urban areas is close to one child per woman or lower – one of the lowest rates in the world. Yet the SRB in these areas is less skewed than in rural areas, where fertility is higher. All of which shows that factors other than political and demographic constraints are at play in Chinese sex-selective practices.

Authoritarian birth control policies, introduced at a time when fertility had already considerably decreased, are an additional factor that prevents households from adjusting their fertility to obtain children of the desired sex. Several studies have attempted to estimate the exact effect of the birth control policy on the deficit of female births in China (Bulte et al., 2011; Ebenstein, 2011; Li et al., 2011). Elsewhere in Asia, demographic policies have been less drastic than in China and the fertility decline is mainly voluntary.<sup>(39)</sup> Fertility has also fallen substantially in most eastern European countries since the 1990s, in parallel with the increase in the proportion of male births.

## 5. Future outlook

As with the baby boom in the West, the rise in the SRB was entirely unexpected and contradicted all the demographic scenarios. But unlike the rise in fertility in the mid-twentieth century, the triggers and causes of which are still the subject of debate (Van Bavel and Reher, 2013), the components and determinants of the rise in the SRB are better understood. The factors behind its gradual rise can be explained using the proposed interpretative framework. The timing of this increase can be linked to supply factors, including new reproductive technologies and the legalization of abortion. Our framework

(38) Regions with ethnic minorities are given more flexibility and have higher fertility.

(39) But the decrease in fertility may be largely responsible for the rise in demand for boys and in the SRB, as demonstrated by a study on India that provides new instruments for assessing sex preference (Jayachandran, 2014).



also explains many of the internal variations between social groups presented above, resulting from differences in the intensity of gender bias, the stage in the demographic transition or access to sex selection techniques. The frequency of prenatal sex selection may even be seen as a product of the respective intensity of the three factors. Thus in India, all other things being equal in terms of fertility and access to new technologies, the strong imbalance observed in a region such as Punjab undoubtedly reflects an extreme preference for sons.<sup>(40)</sup> Similarly, while the conjunction of these three factors explains the existence of skewed sex ratios, the absence of one or two of them also reveals the factors behind a normal SRB. This is the case in the Middle East, owing to strict regulation on abortion, western Europe, where there is no marked sex preference, and some countries in Africa, where fertility remains high and flexible.

This analysis also sheds light on how the situation could evolve in coming decades. Certain countries and social groups can be considered as vulnerable because the dissemination of new reproductive technologies could lead to the emergence of prenatal sex selection. The countries concerned are mainly those with a strong son preference but in which one of the other conditions – such as access to sex-selective abortion or pressure on couples owing to reduced fertility – does not exist. The situation could very well evolve with the modernization of the healthcare sector, a rise in living standards, a decline in fertility or the legalization of abortion. The countries in question cover a large part of the Muslim world, from Afghanistan to the Maghreb, and include large nations such as Egypt and Pakistan. Others include the Melanesian area, extending from the east of the Indonesian archipelago to Fiji, dominated by patrilineal kinship systems. Sub-Saharan Africa is a more heterogeneous area as it includes a wide range of family systems, but recent research suggests that major countries such as Nigeria may be concerned owing to a preference for boys (Milazzo, 2014; Ohagwu et al., 2014; Rossi et al., 2015).

Meanwhile, the SRB has recently risen across the entire Indo-Gangetic plain and in central Nepal. These areas are witnessing an initial emergence of prenatal sex selection and the wider dissemination of this practice throughout society. Many other countries and regions mentioned here appear to have already reached a plateau, with high but stable sex ratios at birth. This reflects a balance between the intensity of son preference and socio-demographic constraints including access to sex selection technologies and a fertility decline. This equilibrium varies sharply from one region to the next, with maximum levels ranging from around 110 in the western Balkans to 125 in many parts of India and China. These differences undoubtedly reflect the specific force of patrilineal constraints and Malthusian pressure.

(40) As early as 1991, the sex ratio of children was close to 115 in Punjab with a fertility level still above 3.5 children per woman. In comparison, an equivalent sex ratio was attained in China only several years later, even though Chinese women already had no more than two children on average at that time.



The sex ratio at birth now appears to be declining in a number of regions, including northwest India (Punjab, Haryana and Delhi), and similar trends may soon be observed in some eastern European countries where, according to recent data, the proportion of male births has dipped slightly. It is still too early to confirm whether these regions have entered a new transitional phase, marked by a regular decrease in prenatal discrimination against girls, or to clearly identify the factors behind that decrease. But the trend is visible in numerous regions, including in China at national level, where official statistics indicate a decline in the SRB (Figure 2). South Korea naturally stands as the model of this cyclical vision, with prenatal sex selection losing its justification as women assume a more equal role in families and society. South Korea's regular decrease in the sex ratio at birth in last 20 years, to a level close to 106 today, is the only existing example of a return to normal, although Georgia appears to be a second example of a completed transition. This analysis suggests that the disruption in the sex ratio at birth may simply be a temporary mechanism to enable long-standing patrilineal family systems to adjust to demographic modernity as illustrated by growing control over fertility (Guilmoto, 2009).

This theoretical approach based on three factors also provides a basis for discussing the potential determinants of the expected return to normal of the sex ratio at birth. It is hard to imagine a sharp upturn in fertility, even in China if its restrictions on family size were lifted. Access to prenatal sex selection methods is unlikely to decline very much, despite the bans on prenatal sex diagnosis implemented in China, India and Vietnam, among others. Consequently, it is mainly the gradual erosion of gender bias that will trigger a turnaround in the sex ratio at birth. In this respect, the most developed regions and cities and the higher occupational categories should be the first to return to a natural SRB, since education, lifestyle, access to employment and recourse to the law will serve to undermine discrimination against women and the domination of traditional family systems. This is notably how Cai (2014) diagnoses current trends in China.

## V. Medium- and long-term impacts

Throughout the twenty-first century, skewed sex ratios at birth will impact the demographic structures of the countries concerned, which account for 40% of the world population. These imbalances are neither temporary nor reversible and will affect population pyramids throughout the lifetime of the birth cohorts in question. The consequences of these ratios are a key topic in demographic research and are stimulating the development of new simulation tools, formerly focused only on age-structural changes. They are also of interest to other social sciences, including sociology and economics, since the growing masculinization of the adult population will lead to an entirely new situation. The singular character of this new and unprecedented demographic regime has naturally

been factored into “fictional” future population scenarios, some of which are thoroughly alarmist (Hudson and Boer, 2004; Poston et al., 2011). Here we will focus on the implications for demographic structures, paying limited attention to the possible effects on social systems.

## 1. Missing births, girls and women

Using the sex ratio as a measure of the intensity of imbalances remains relatively abstract for a large part of the public, and more often than not concrete figures are used to describe the effects of prenatal discrimination. The first of these should be the number of sex-selective abortions, but this figure is unavailable because the sex of the fetus is never registered. Indirectly, women’s reported reasons for abortion are of highly uncertain quality and abortion itself is known to be under-recorded in surveys (Rossier, 2003).

A more accessible figure is that of missing births. These can be estimated on a counterfactual basis by comparing the observed sex distribution to that obtained with a natural sex ratio. They can also be calculated from the number of infants below one year of age (Cai and Lavelly, 2003; Jha et al., 2011; Kulkarni, 2007). Missing female births in China can thus be estimated at between 700,000 and one million a year since 1990 (Jiang et al., 2012). These figures account for more than 10% of births in the last 20 years. It can also be considered that the number of sex-selective abortions, in the absence of other forms of prenatal discrimination, corresponds to that of missing girls.<sup>(41)</sup> China’s National Commission of Healthcare and Family Planning estimates the number of abortions at 13 million a year (*Time*, 13/09/2013), of which sex-selective abortions therefore represent a minor share. But these estimates of missing births are determined on the basis of the natural SRB, which cannot be accurately determined in most of the countries concerned given the lack of regular series from civil registration for the period before prenatal sex selection. In India, a calculation based on a natural level of 106 male births per 100 female births (rather than 105) would reduce the estimated deficit of female births by 120,000 a year in the last decade, equal to a 17% decrease in missing female births.<sup>(42)</sup>

A more complex calculation consists in estimating the total missing female population at a given moment, or the famous “missing women” first described by Amartya Sen (1990), who assessed their number to be 100 million worldwide. These figures reflect the impact of all discriminatory mechanisms, combining the effect of prenatal sex selection with all other forms of excess female mortality from childhood through to old age. The simplest calculation method involves comparing the sex ratio of the entire population or calculating the ratio of this

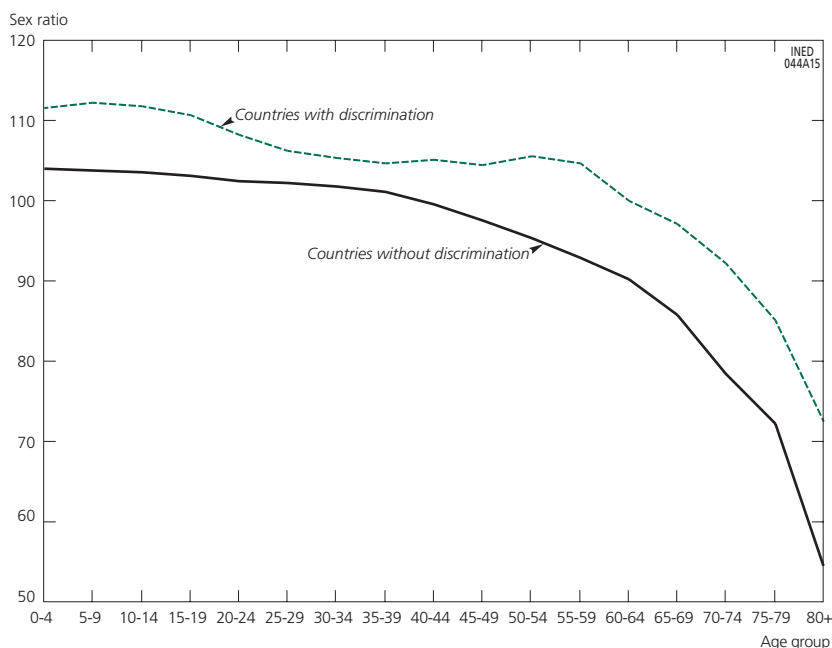
(41) However, the effective desire to practice prenatal sex selection is twice as frequent, since half of the pregnant women, expecting a boy, will not need to have an abortion.

(42) The SRB has never fallen below 106 in China. But ratios of under 105 have been observed in some Indian states with reliable vital statistics and not affected by prenatal discrimination, such as Kerala and Karnataka.

figure to a sex ratio determined on the basis of a reference region or models of stable populations (Anderson and Ray, 2010; Klasen and Wink, 2003).

The preferred calculation method is by age group, in order to calculate the number of missing women relative to the presumed normal distribution of sex ratios by age. Figure 3 shows sex ratios in world countries divided into two groups: one with well-established prenatal discrimination (including India and China) along with other Asian countries with high excess female mortality (Bangladesh, Pakistan) and the other being the rest of the world where the sex ratio is considered as normal.<sup>(43)</sup> In the second group, the sex ratio is close to 104 after birth then falls gradually owing to excess male mortality. It reaches 100 at around age 40 and then declines rapidly as male mortality increases faster than that of women. The countries in the first group have a parallel profile but one showing a systematic discrepancy since the sex ratio is always higher than in the rest of the world. This gap between the two curves fluctuates beyond the age of 20, reflecting the impact of each birth cohort and its own singular experience in terms of prenatal and postnatal discrimination. It corresponds to the surplus of men recorded in countries with strong discrimination, which is symmetrical to the deficit of women.

Figure 3. Sex ratio by age groups according to the presence or absence of sex discrimination in 2010



Source: UNFPA (2012a).

(43) See UNFPA (2012a), from which these figures are taken, for more details on the method.

Using a more systematic approach, it is also necessary to consider the effects of mortality levels, upon which male-female mortality differentials also depend. The most recent assessment uses 2010 UN figures and compares the sex ratio by age in countries with skewed sex ratios to the theoretical sex ratio deduced from age group and life expectancy data (UNFPA, 2012a). The results, shown in Table 4, give a total of 116.8 million missing women in the 13 countries studied, or nearly 8% of the observed female population. China and India alone account for over 90% of these women. Nearly 40 million of them would have been less than 20 years old in 2010 – a population born after 1990, when sex-selective abortions became more widespread. According to this source, the missing girls, many of whom have never been born, account for 15% of their age group in China and 8% in some countries of the Caucasus.

Table 4. Estimated number of missing women in 2010

	Deficit of females (all ages)		Deficit of females aged under 20		Share of females aged under 20
	Total (thousands)	%**	Total (thousands)	%**	%**
Afghanistan	860	5.7	265	3.0	30.8
Albania	45	2.8	21	4.2	46.7
Armenia	*	–	35	8.4	–
Azerbaijan	*	–	111	8.3	–
Bangladesh	2,082	2.8	416	1.4	20.0
China	67,589	10.5	25,112	15.0	37.2
Georgia	*	–	24	4.6	–
India	42,687	7.2	12,618	5.3	29.6
Montenegro	*	–	3	3.6	–
Nepal	*	–	125	1.8	–
Pakistan	2,833	3.3	206	0.5	7.3
South Korea	608	2.5	336	6.2	55.3
Vietnam	*	–	139	1.0	–
Total	116,829	8.1	39,411	7.7	33.7

\* No significant deficit or statistically calculable deficit for the whole.  
 \*\* Percentage of the female population of each country.  
 Source: UNFPA estimations (2012a).

Ideally, these indirect estimates of missing women would also take account of poorly documented variations in the natural SRB level, the effect of international migration on national populations and differences in the quality of census responses given by men and women. Concerning this last point, setting aside the potential under-enumeration of young girls in China, it is men who are more likely to slip through the net of the census owing to migration,

tax or conscription. In fact, raw census data are often corrected by the UN, especially for young adults.

To conclude, missing women are in no respect purely the result of prenatal sex selection. As shown by Figure 3, several cohorts born before the 1980s – which saw the emergence of sex selection methods – are also affected by clearly skewed sex ratios. Very little is known about excess female mortality in Africa owing to imprecise measures, but the phenomenon is obviously of great importance (World Bank, 2012). The scale of the global deficit of women observed today results as much from excess female mortality as it does from prenatal sex selection, as demonstrated by a recent study which estimated a total of 126 million missing females in 2010 (Bongaarts and Guilmoto, 2015).

## 2. Impact on the marriage market

Variations in the level of male births must now be factored into population projections to determine the potential configurations of the future age-sex structure. A range of national projections exist for different future trends in the sex ratio at birth (Cai and Lavelly, 2003; GSO, 2011; UNFPA, 2013a). These projections show that if the proportion of male births remains unchanged, the sex ratio of the Indian population will remain steady throughout the twenty-first century while rising gradually to 115 in China. Even if the SRB were to quickly return to normal, the populations of China and India will remain majority male until the end of the century (Guilmoto, 2010a). One of the mechanical effects of the present-day deficit in female births will be to reduce the population of adult women and hence the number of future births.

Research in the area has generally focused on the adult sex ratio and the mechanisms of family formation. Masculinization refers to a classic question of formal demography on the heterosexual marriage squeeze, explored in particular by Louis Henry (1966) using the example of France between the wars. Demographers sought from an early stage to formally document the effect of skewed sex ratios on marriage.<sup>(44)</sup> But the expected intensity of future female deficits is on a different scale altogether compared to what was observed in the past, since the surplus of male births – often exceeding 10% of the total birth cohort – will impact the marriage market of the two most populous countries in the world two or three decades from now. According to Huang (2014), the surplus of men of marriageable age in China will rise by roughly 1.3 million a year over the next two decades, reaching a total surplus of 41 million men aged over 22 by 2041.

An initial approach to measuring the marriage squeeze consisted in calculating the number of newly married individuals expected in the coming decades based on demographic projections and a set of nuptiality parameters by age and sex. The surplus of male births is reflected mechanically in an

(44) Research was stimulated in the 1980s by Schoen's formalizations (1983).

excess of prospective grooms in two decades' time, but the mechanism depends on age-specific marriage rates. Comparing the number of expected male and female marriages provides an initial illustration of the future marriage squeeze, that will lead in the long term to a male surplus of 20% in China and 15% in India if the sex ratio at birth remains unchanged. Uncertainty over the exact SRB level and how it will evolve in the future, combined with varying assumptions on trends in nuptiality and other demographic parameters, have given rise to numerous publications, most of them focusing on China (Ebenstein and Sharygin, 2009; Huang, 2014; Jiang et al., 2014).

Two points in particular should be highlighted to better understand future trends. First, early and universal female marriage in China and India are likely to gradually disappear.<sup>(45)</sup> Later female marriage and the emergence of permanent singlehood, as seen in South Korea and Japan, will serve to further increase the skewed adult sex ratio. Second, the sharp fall in fertility in Asia has led to a regular decrease in the size of birth cohorts. As a result, cohorts of future husbands, marrying at a later age, are now larger than those of their prospective wives, as they were born several years earlier. Much of the marriage squeeze results purely from this gradual reduction in the size of birth cohorts. These two trends suggest that the effects of female nuptiality and the declining number of births, together with skewed SRBs, will further intensify imbalances among populations of marriageable age.

However, these cross-sectional calculations do not accurately reflect disturbances in the marriage market. This is because rather than exiting the marriage market, the members of a cohort unable to form a union at a given time continue to “overload” the market until they reach a given age, generally set at 50. The calculation based on fixed marriage rates does not take into account the growing number of single individuals remaining in the marriage market. New methods have therefore been developed to construct longitudinal simulations of cohort nuptiality over time. These methods measure the marriage squeeze in more realistic terms, taking account in each period of the new marriage candidates but also of the population remaining single. Because they mainly concern unions, these methods are based on two-sex demographic models and marriage functions, and are highly complex to implement (Guilmoto, 2012a; Jiang et al., 2014). They can be used to make more realistic projections of how the marriage market will be affected by the gradual accumulation of single men. By 2050, the effective number of men seeking to marry is expected to exceed the number of eligible women by over 50% in China and India, giving an idea of the extent of marriage market saturation.

Several findings of these longitudinal simulations are important to the understanding of future demographic scenarios:

- Skewed SRBs have a cumulative effect on the marriage market;

(45) Today less than 1% of 50-year-old women in China and India are single (United Nations, 2013b)

- Owing to that cumulative effect, the marriage squeeze is much more pronounced than suggested by examining age structures alone;
- The marriage market will remain disrupted after the SRB returns to normal due to the later marriages of previous cohorts;
- An increase in the age difference between partners would considerably reduce the marriage squeeze, but a rise in female singlehood would have the opposite effect;
- The expected surpluses of single men in China and India are so large that no correction through international migration appears plausible.

These developments appear to be leading countries with patrilineal traditions to an entirely new paradigm. Given their excess number, a share of the male offspring so desired by parents today may in the future find it impossible to marry and perpetuate their family line. In other words, the system appears demographically unsustainable and today's prenatal sex selection favouring boys will, in the long term, erode the foundations of patrilineal systems based on family reproduction through the male line.

### 3. Social consequences

Skewed SRBs assumed their full extent only in the late 1990s. Their effect on the adult sex ratio and the marriage system is still limited, except in parts of China and India that were affected earlier by surplus male births. This is notably the case in northwest India and the inland Chinese provinces where the emigration of women is also an issue (Davin, 2007). These regions can thus serve as laboratories for studying the potential effects of the growing deficit of wives on social arrangements.

A growing number of men will be obliged to marry later or be faced with forced singlehood; their number will rise to tens of millions in China and India (Guilmoto, 2012a). Field studies are already revealing the desperation, growing marginalization and changing sexual practices of men forced to remain single in China and India (Li et al., 2010; South et al., 2012; Trent and South, 2012; Yang et al., 2012; Zhou et al., 2011). This imbalance may have an effect on violence towards women, prostitution and human trafficking, emigration and the propagation of AIDS, as already illustrated by several studies (Edlund et al., 2013; Hesketh and Xing, 2006; Schacht et al., 2014; South et al., 2014; Tucker et al., 2005).<sup>(46)</sup> These demonstrations are based on both local field analysis and more abstract modelling which attribute to skewed adult sex ratios a range of effects on social behaviour. Bien et al. (2013) provide an invaluable meta-analysis of existing work. More positively, demographic masculinization appears to encourage saving among men seeking to accumulate wealth as a means to

(46) The shortage of brides in the different regions of Asia has increased human trafficking (Blanchet, 2005; Davis, 2006; Le Bach et al., 2007). Trans-regional marriages are particularly unstable (Kukreja and Kumar, 2013; Liu et al., 2014).

attract marriage partners, and may even affect exchange rates in China (Du and Wei, 2011; Griskevicius et al., 2012; Wei and Zhang, 2009). The theoretically more optimistic forecasts concerning women and their improved position in the marriage market remain to be confirmed.

Within each of these countries, bride migration could be oriented towards areas or groups with a shortage of women, as is the case in northwest India and eastern China (Kaur, 2004; Mishra, 2013). But owing to hypergamy, it will be the men from the most disadvantaged groups and regions that will bear the full brunt of the marriage squeeze. These mechanisms are not unknown in European countries where the rural exodus led to a rise in singlehood among rural men (Jegouzo, 1972). But their impact will be heightened in Asia by structural imbalances in birth cohorts. Inequalities in social conditions could translate into inequalities in access to marriage, with a growing proportion of men unable to marry for reasons of low income, poor health or disadvantaged social origin. Researchers have also focused closely on the related topic of international marriage migration. Some Asian countries that are wealthier but equally impacted by the rise in the sex ratio, including Taiwan and South Korea, have attracted a high number of potential brides from less wealthy neighbouring countries such as Vietnam and China (Kim, 2008b). The foreseeable female deficit in China and India is too large to be relieved by migration, be it the departure of single men or the arrival of potential brides.<sup>(47)</sup>

## VI. Political initiatives and issues

It took many years to confirm the growing imbalance in the sex ratio at birth, both statistically and through field studies. Political responses came even later and remain hesitant, controversial and insufficiently assessed.

### 1. From indifference to action

Resistance to acknowledging the scale of the rise in the SRB and its relationship to sex-selective abortion stems from a number of factors that are important to keep in mind when trying to understand obstacles to the global understanding of the phenomenon. First of all, the worsening of the situation was unexpected and historically unprecedented, beyond the bounds of all known demographic paradigms. Secondly, it was manifested through demographic indicators such as the SRB that are little researched and often of poor quality. Knowledge of the exact situation of countries as large as China and Pakistan remains poor owing to limited or contradictory statistical sources or difficulties in conducting field surveys. But looking beyond these theoretical and methodological hindrances, the rise in the sex ratio has suddenly lifted

(47) Some countries in Eastern Europe – such as Armenia and Albania – may, however, benefit from the balancing effects of the emigration of young men.



the veil on the scale of discriminatory practices and millions of sex-selective abortions. The phenomenon runs counter to the rapid social development that characterizes these countries of Asia and Eastern Europe. The situation suggests a demographic “penalty” for the coming decades that will undermine the famous demographic bonus resulting from the transition of age structures in Asian countries.<sup>(48)</sup> The spontaneous response to suspicions of sexual discrimination has often been denial, with deniers pointing to the lack of reliable data, the absence of direct proof of sex-selective abortions and the presumed role of other factors such as social crises and specific biological characteristics.

Paradoxically, it was the success of birth control policies that helped to fuel the rise of prenatal sex selection; this is an unwanted and even pernicious effect of the development of reproductive technologies and fertility decline. This paradox sometimes prevents governments in Asia from taking any measures against sex-selective abortion that might call into question their family planning policies. Groups fighting for abortion rights have also been on the defensive, seeing the crackdown on prenatal sex selection as a subterfuge to oppose access to abortion. These risks are illustrated by the recent mobilization around sex selection issues by pro-life groups in the United States (Hvistendahl, 2012). Lastly, the practice of modern sex selection was introduced by the dominant classes and often to the benefit of the powerful medical industry. The main guilty parties, then, are often to be found within the groups that form the political and economic elites (Patel et al., 2013), who may have little motivation to eradicate these sex-selective practices.

Yet prenatal sex selection and its future consequences clearly represent a new challenge for public policies. The situation is a classic case of the “tragedy of the commons” whereby the individual and opportunistic behaviour of parents, artificially favouring male births, later leads to a collective catastrophe through the skewed adult sex ratio.<sup>(49)</sup> The current situation in which individual interests prevail over collective needs calls for intervention from civil society and the state. The challenge for governments is similar to the one they faced when family planning policies were introduced with the aim of changing demographic behaviour that was deeply rooted in traditional social systems. Only the most libertarian groups advocate total *laissez-faire* and the withdrawal of the state, assuming, like Becker and Posner (2009), that the marriage market and the SRB will adjust automatically to the new conditions.

It should also be noted that while international organizations – spearheaded by the United Nations Population Fund – and Western countries focus attention on the evils of gender preference and bias in the debate about skewed sex ratios,

(48) The demographic bonus corresponds to the rise in the active population relative to the population of young and old people. This phenomenon, resulting above all from the sustained fertility decline, is often put forward as a reason for the “Asian miracle” since the 1980s (Bloom et al., 2003).

(49) See Hardin (1968) and Guilamoto (2009). This generic model deserves qualification since the crisis will affect different social groups in different ways.

Asian countries stress their harmful consequences, especially on the adult population in a few decades' time (WHO, 2011). This difference of approach highlights the contrast between intrinsic and consequentialist morality; it thus shapes the content of information campaigns against prenatal sex selection that oscillate between immediate condemnation of sex discrimination and the elimination of girls on the one hand, and warnings of the distant threat to future collective well-being posed by surplus male births on the other.

## 2. From condemnation to encouragement

Our interpretative framework suggests that governments can act equally well on supply and demand, and even on the pressure of fertility in the case of birth control policies. A number of countries, including India in 1994, introduced an early ban on prenatal sex selection that targeted couples and, above all, the medical sector. But as abortion remained legal and ultrasound scans were vital for the monitoring of pregnancies, the ban could only apply to disclosing the sex of the fetus. Clinics and hospital employees were directly concerned, especially in the private sector, which grew in Asia at the same rapid pace as in the former socialist republics. It was clear that there was a contradiction between the interests of this economic sector and the principle of prohibiting prenatal diagnoses in early pregnancy. The enthusiasm shown by women for reproductive modernity, evidenced in repeated ultrasound scans during their pregnancies, has been described notably for Vietnam (Gammeltoft, 2014). But beyond the half-hearted efforts of the medical community to implement the ban, it proved very difficult to monitor compliance owing to the ease with which practitioners could discreetly communicate the unborn child's sex to the patients. Such bans are manifestly difficult to implement (Joseph, 2007; Wexler, 2006).

Groups defending abortion are also afraid that such policies will create further obstacles to abortion (Ganatra, 2008). More broadly, the fight against sex-selective abortion following prenatal diagnosis has been perceived as a threat to women's right to make their own reproductive choices, even if their decisions are liable to reinforce sexism. According to this position, the fight should be focused exclusively on son preference – the main reason for prenatal sex selection – with abortion being merely one of a number of ways of obtaining children of the desired sex.

As with support for fertility, some of the policies concentrate more on enhancing the economic value of girls than on directly opposing a deeply rooted system of values. By supporting the parents of girls, these policies aim to offset some of the disadvantages linked to daughters by introducing direct subsidies (birth bonus, marriage allowance, etc.) or indirect subsidies (scholarships, free services, tax credits, etc.). Introduced in a number of Indian states, these initiatives make female births more attractive and may serve as positive incentive mechanisms, unlike measures aimed at prohibiting sex-

selective abortions. They may also have numerous beneficial effects in the field of health or education. However, they are costly and ineffectively targeted at the poorest populations, who are the most receptive to the material advantages on offer but practice sex selection less widely than more affluent groups. They may also promote corruption, as suggested by Sekher's study (2012) on India.

### 3. From jurisdiction to behaviour

While sex-selective practices are difficult to control by law, promoting gender equality is largely dependent on efforts to update the legislative system. More specifically, family law has long been tainted by gender bias in family authority and the transmission of property. Like the USSR, the People's Republic of China was a forerunner in this respect, gradually eliminating all discriminatory social and economic measures, notably those concerning traditional marriages. But after the 1990s, the withdrawal of the state and the liberalization of the economy in socialist countries weakened the legal bedrock and family systems regained part of their ancestral role, leading to the return of patriarchal systems, as described by Karl Kaser (2008) in Eastern Europe. Land reform in China in the 1980s, with privatization benefitting the male sex, played an important role in increasing the SRB according to some observers (Almond et al., 2013; Eklund, 2011). In South Korea, it was traditional family law, based on Confucian ethics and founded on the supreme authority of the family head, that became the target of reform: the patriarchal provisions characteristic of this traditional law, built upon the notion of the family head, were gradually abolished through reforms in 1990 and then in 2005. In India, efforts have concentrated on rules of inheritance and the transmission of property, the aim being to break the tradition of excluding daughters that has long prevailed across much of the country (Agarwal, 1994; Arokiasamy and Goli, 2012).

A considerable gap still often exists between formal equity under law and actual discriminatory practices based on family norms. To give just a few examples, dowries have survived unscathed in India despite being formally prohibited for several decades, and inheritances favouring sons remain the norm in the Caucasus even though all offspring are equal under the law. With regard to family practices and gender relations, a tacit set of norms exists that guides social practices and remains beyond the reach of legal provisions. For example, it lays down rules on partner choice, inter-generational cohabitation and solidarity, and the transmission of wealth. It is implemented by the powerful yet informal institutions of family, kin, community, caste and clan. The government has very little power over these traditional entities. Market institutions, which are supposed to replace public action and the family, particularly in the areas of social protection and employment, have yet to be fully instated. While it is difficult to sum up the situation in countries as different as Albania, Azerbaijan, India and China, it is clear that many aspects of society and the economy, such as access to employment, housing, credit,

social aid, marriage and pensions, continue to be controlled by traditional institutions, in contrast to industrialized countries where the State and market mechanisms play a preponderant role.

To address this relative inertia in social norms, numerous policies have been introduced in order to change perceptions, attitudes and behaviour through national and local campaigns, with the fight against prenatal sex selection calling for a specific approach (MacPherson, 2007). The promotion of gender equality, and notably the potential of women, is central to these campaigns, aimed at transforming gender-based perception systems and denouncing traditional practices as archaic behaviour. A broad range of tools has been implemented in each country to target the populations concerned, including TV films, initiatives in schools, public campaigns, engagement with the medical community, and the involvement of religious figures (UNFPA, 2013b).

## VII. The frontiers of research

The masculinization of births has generated a growing amount of research, with demographic analysis making a key contribution in this area. The 1990s saw the confirmation of skewed sex ratios at birth, while work in the 2000s sought to explore causes and variations more systematically. Current research is focusing more directly on future consequences, relying on field analysis in the main affected areas and work on population trends based on demographic models. Four main research topics are set to develop further in the coming years. Two of them directly concern formal demography: first, the need to deepen and broaden sources in order to better measure a phenomenon that is imperfectly captured by available demographic monitoring tools; and second, more theoretical and model-based work to understand the effects of skewed sex ratios on age structures, the marriage market and family formation. The third research area is more thematic and centred on understanding son preference. It is aimed at gaining a firmer grasp of the origin of skewed sex ratios and their evolution in fast-changing societies. The fourth focus concerns public action and seeks to better understand the effects of policy on discriminatory behaviour and assess its tangible effects. These four emerging fields are described in the following paragraphs.

### 1. The extent and evolution of skewed sex ratios at birth

Depending on the statistical context, the primary objectives in terms of data are to detect the existence of skewed sex ratios at national and regional levels, and then to identify the most affected groups and birth orders. An additional objective is to identify trends, both in the deterioration of the sex

ratio at birth in new regions and in the onset of lasting decreases in prenatal sex selection in the most affected areas.

While the phenomenon has been observed for over 20 years, basic data on surplus male births is often still lacking. Only modest progress has been made in collecting vital statistics. China, India and Indonesia, three of the most populous countries on the planet, still have no detailed data, although the recording of births has improved. There is a lack of reliable data on the sex ratio by parity in India and on the annual trend in that ratio in the Chinese provinces – despite the fact that ten of these provinces have populations of over 50 million. Other countries mentioned in this article, with sex ratios that may worsen in the future, such as those in the Arab world and some African nations, are in a similar situation in terms of data.<sup>(50)</sup> Yet just having separate records of the SRB by birth order would often be sufficient to assess the situation in a country as well as trends and disparities at regional level.

In the absence of that information, we must rely on censuses, notably via available microdata, to obtain a reliable picture (complete and statistically significant) of skewed sex ratios and their social, demographic and regional correlates. These estimates are necessarily indirect and the methods employed need to be critically assessed to identify the best procedures. Figures based on major demographic surveys can at best provide indirect indicators of existing imbalances. While it remains true that only vital statistics provide the necessary tools to spot trend reversals as they occur, indirect estimation procedures must be refined and diversified to identify trends and contrasts between social groups in the coming years.

## 2. Transformations in gender preferences

Fertility levels and the availability of prenatal sex selection services – two new conditions that have led to increases in the SRB – have changed rapidly in the last 30 years. By contrast, son preference is a cultural variable deeply rooted in social systems that change only slowly over time. Social groups differ in many ways, and synthetic indicators are needed to assess the intensity of preferences. As shown by the experience in South Korea and Taiwan, it is clear that son preference may ebb rapidly, but such trends cannot be measured without the appropriate tools (Chung and Dasgupta, 2007; Lin, 2009).

It is equally vital to understand the contextual variables behind the persistence of sex discrimination. Researchers today are exploring the structural role played by gendered institutions such as kin, family, school and the job market on social and economic variables (Branisa et al., 2013; Dilli et al., 2014). The central role of kinship systems in prenatal discrimination is an illustration of this and should be examined in more detail. Some social transformations,

(50) We do not mention Latin America here since no trace of marked son preference has been observed there. See for example Chiavegatto Filho and Kawachi (2013) on Brazil.

such as urbanization and education, have so far largely failed to generate the expected beneficial results, but it is likely that the urban middle classes will serve as spearheads of the SRB transition as patriarchal norms lose their hold. While anthropologists provide important information for understanding family systems, our understanding of the dynamics of those systems is rather less clear. Yet kinship systems are also changing, impacted by the decrease in family size, by migration and urbanization, by the gradual decline of agriculture, and by the introduction of a modern social protection system. Research, then, needs to focus on the factors of change most likely to generate a transformation in lineage structures, family systems and gender inequalities.

### 3. Understanding the future impacts of today's imbalances

The exact figure corresponding to the deficit of women, and in particular that caused by prenatal sex selection, is still calculated indirectly and on the basis of national aggregates. The specifically demographic simulation of the effects of skewed sex ratios on the marriage market poses methodological challenges for research owing to the complexity of the models required. Assortative mating models – reproducing preferential processes in the choice of a partner on the basis of social, economic and geographic variables – are another avenue of research. Factoring migration trends into these imbalances will provide a further layer of complexity for analysis. Disaggregation by social group will be necessary in order to understand the exact price paid by men from disadvantaged backgrounds in terms of exclusion from marriage, as illustrated by a recent study on India that included education variables in marriage market simulations (Kashyap et al., 2015).

The effects of current imbalances must be simulated at regional level to take account of extreme imbalances, and in particular the amplitude of variation at infra-national level. At provincial level, these marriage models must also include migration variables, as it is important to take into account the specific migration dynamics observed in the regions most affected by the masculinization of births. This is true for the landlocked regions of China, which are experiencing extreme outward migration, especially by women, to the coastal cities, and for the Punjab region in India, which in contrast exerts a powerful attraction on male workers from outside. Migration differences between men and women can lead to disruptions that are just as severe for the sex distribution in departure areas as the sex ratio of locally born cohorts.

Socio-demographic research will naturally focus on the adjustment of social systems to changing demographic conditions (Kaur, 2013; Larsen and Kaur, 2013). The scenarios put forward, some of them informed by an overtly catastrophic view of the future behaviour of millions of individuals excluded from marriage, fail to take account of the malleability of social systems and their ability to adapt and show resilience. Practices once seen as marginal or deviant, such as permanent singlehood, childlessness, homosexual unions

and exogamous or heterogamous marriages, are set to develop. Women may benefit to a certain extent from more favourable marriage market conditions and the dowry system in India may be weakened as a result.<sup>(51)</sup> In China, the decline in fertility and the skewed sex ratio may combine to give young women a powerful new role in family organization (Fong, 2002). At the same time, in response to the bride shortage, pernicious forms of adjustment involving violence or crime may replace the failing family system and directly threaten the female population. The situation of men is also set to worsen, above all owing to the potential marriage squeeze, and a greater understanding of these issues should help to reshape gender perspectives.

#### 4. The effects of policies to eradicate prenatal discrimination

Governments in a number of countries have introduced measures to fight against prenatal sex selection. The first such regulations were introduced in South Korea, China and India in the 1990s and were strengthened and diversified in the following decade after the censuses in the 2000s revealed that the situation had deteriorated in several countries. Further governments have since acted likewise. Yet there is uncertainty about whether the policies are truly justified and, more prosaically, about their effectiveness. Debate should be informed by the lessons drawn from birth control policies, whose exact impact on demographic indicators and whose financial and social costs still divide opinion. The situation in South Korea is emblematic in this respect. Not only are the details and scale of the initiatives taken since 1990 poorly documented, but their exact impact on the change in the sex ratio at birth is unknown. The situation is particularly paradoxical given that the trend in the sex ratio at birth changed direction precisely when these policies were introduced. Over the last decade, China has also implemented an integrated programme, Care for Girls, addressing many aspects of the issue and for which only qualitative assessments currently exist (Murphy, 2014; Zijhuan et al., 2012). India, on the other hand, has rolled out a panoply of regional and national initiatives. Information on how these policies work and their results remains sketchy, but some of them, such as efforts to eradicate infanticide, may have had tangible effects (Srinivasan and Bedi, 2011).

The impact of these tools in the fight against prenatal discrimination remains subject to conjecture that is rarely based on detailed studies and is often pointlessly polemical. It is vital, then, to apply all the instruments available for measuring the effectiveness of these policies – be they trend analyses, qualitative surveys or randomized experiments – to the initiatives already taken by governments and civil society organizations (Nandi and Deolalikar, 2013; Sinha and Yoong, 2009). The central aim will be to measure the precise effect of these initiatives on trends in the sex ratio at birth. But the obstacles

(51) It is often predicted that dowries will decrease as a result of the emerging male surplus (Das Gupta et al., 2003). For a more qualified analysis, see Jeffery (2014).

to these policies and their limits in terms of financing, implementation, management and coverage, and even in terms of reduced access to reproductive health, must also be examined in depth.

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### Christophe Z. GUILMOTO • THE MASCULINIZATION OF BIRTHS. OVERVIEW AND CURRENT KNOWLEDGE

The masculinization of births is a recent phenomenon resulting from prenatal sex selection. This paper reviews recent research on imbalances in the sex ratio at birth and the corresponding mechanisms, determinants and future implications. The mechanisms affecting the sex ratio at birth are reviewed, with an emphasis on factors relating to sex discrimination. The figures available provide an overall picture of skewed sex ratios since the 1980s in Asian and eastern European countries. Large differences in the male surplus are also observed across birth orders, region and social group, owing above all to the conjunction of three phenomena: a preference for male children inherited from socio-familial systems, the emergence of assisted reproductive technology enabling prenatal sex selection, and a decrease in fertility that heightens the risk of not having a son. Recent research has analysed the demographic consequences of the masculinization of births on the future composition of the population and explored how social systems may adjust to these imbalances, with political responses to prenatal discrimination still proving relatively ineffective. The article also reviews some of the main future research avenues.

### Christophe Z. GUILMOTO • LA MASCULINISATION DES NAISSANCES. ÉTAT DES LIEUX ET DES CONNAISSANCES

La masculinisation des naissances est un phénomène récent lié à la sélection prénatale en fonction du sexe. Cet article fait le point sur l'état de la recherche récente à propos des déséquilibres de sexe à la naissance, ses mécanismes, ses déterminants et ses implications à venir. Les mécanismes qui affectent le rapport de masculinité à la naissance sont présentés en soulignant les facteurs liés à la discrimination sexuelle. Les chiffres disponibles fournissent un tableau des déséquilibres à la naissance depuis les années 1980 dans différents pays d'Asie et d'Europe orientale. On observe également de grandes disparités dans la masculinité des naissances entre rangs de naissance, régions et groupes sociaux, qui s'expliquent avant tout par la conjonction de trois phénomènes : la préférence pour les enfants de sexe masculin héritée des systèmes socio-familiaux, l'émergence de technologies reproductives permettant la sélection prénatale, et la baisse de la fécondité qui accentue les risques de progéniture sans garçon. Les travaux récents analysent également les conséquences démographiques de cette masculinisation des naissances sur la composition future de la population des pays concernés et explorent l'ajustement potentiel des systèmes sociaux à ces déséquilibres, alors que les réponses politiques à la discrimination prénatale semblent assez peu efficaces. Quelques-unes des principales pistes de recherche à venir sont examinées.

### Christophe Z. GUILMOTO • LA MASCULINIZACIÓN DE LOS NACIMIENTOS. SITUACIÓN ACTUAL Y CONOCIMIENTOS

La creciente proporción de masculinidad al nacimiento es un fenómeno reciente ligado a la selección prenatal en función del sexo. Este artículo expone el estado actual de la investigación sobre los desequilibrios de sexo al nacimiento, sus mecanismos, determinantes y consecuencias futuras. Los mecanismos que afectan la proporción de masculinidad al nacimiento son presentados insistiendo en los factores ligados a la discriminación sexual. Las cifras disponibles ofrecen un panorama de los desequilibrios de sexo al nacimiento, desde los años ochenta y en diferentes países de Asia y de Europa oriental. También se observan grandes disparidades en la masculinidad de los nacimientos según el rango, entre las regiones y los grupos sociales, que se explican principalmente por la conjunción de tres fenómenos: la preferencia por los niños de sexo masculino, heredada de los sistemas socio-familiares, la emergencia de tecnologías reproductivas que permiten la selección prenatal y, en fin, la baja de la fecundidad que acentúa el riesgo de una ausencia de progenitura masculina. Las investigaciones recientes analizan igualmente las consecuencias demográficas de esta masculinización de los nacimientos sobre la composición futura de la población y exploran la adaptación potencial de los sistemas sociales a estos desequilibrios, ya que las respuestas políticas a la discriminación prenatal parecen todavía poco eficaces. Algunas de las pistas de investigación importantes son examinadas.

**Keywords:** Sex discrimination, gender, fertility decline, marriage market, marriage squeeze, assisted reproductive technology, Asia, eastern Europe.

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