

Klasen, Stephan; Wink, Claudia

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## A Turning Point in Gender Bias in Mortality? An Update on the Number of 'Missing Women'

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Stephan Klasen und Claudia Wink:  
A Turning Point in Gender Bias in Mortality?

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Department of Economics  
University of Munich

Volkswirtschaftliche Fakultät  
Ludwig-Maximilians-Universität München

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**A Turning Point in Gender Bias in Mortality? An Update on the Number of ‘Missing Women’**

Stephan Klasen, University of Munich  
Klasen@lrz.uni-muenchen.de

and

Claudia Wink, DEG Cologne  
Wi@deginvest.de

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## 1. Introduction

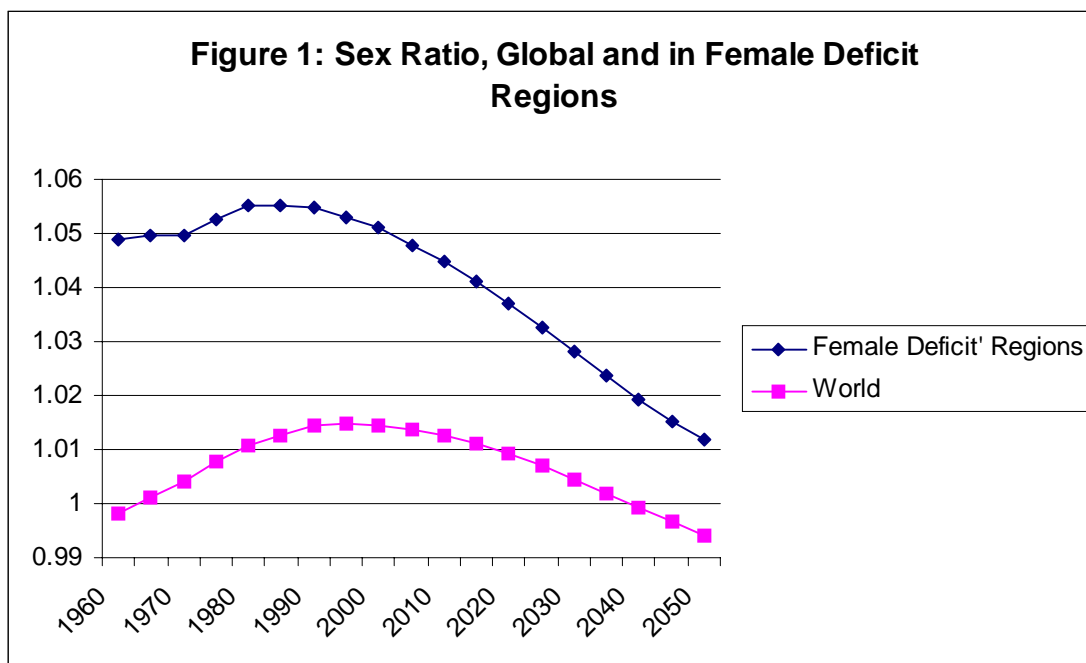
More than 10 years ago, Amartya Sen estimated that some 100 million women are 'missing' as a result of excess female mortality in parts of the developing world, most notably South Asia, China, West Asia, and parts of North Africa (Sen, 1989; Sen 1990). Coale (1991) and Klasen (1994) used more precise demographic techniques and arrived at figures that varied between 60 million (Coale) and 90 million (Klasen). All three estimates confirmed the enormous toll excess female mortality was exacting on women in these parts of the world.<sup>1</sup>

All these estimates 'missing women' were based on demographic information of the 1980s and early 1990s. Since then, there has been considerable speculation about current trends of gender bias in mortality with some observers suggesting a falling intensity while others predicted the opposite (e.g. Klasen, 1994; Das Gupta and Mari Bath, 1997; Dreze and Sen, 1995; Mayer, 1999; Croll, 2000). Figure 1 shows recent projections by the United Nations Population Division of the sex ratio in the world and in the regions where males outnumber females. These estimates suggest that the sex ratio in the female deficit regions, after rising steadily since 1960, is estimated to peak in about 1985 and then are believed to decline quite sharply. Given the high share these regions have in the world's total population, a turning point in the global sex ratio, after a similar rise since 1960, is also estimated for 1995.<sup>2</sup>

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<sup>1</sup> For a more thorough discussion of Sen's contribution to this field of research and the ensuing debate about estimating the number of missing females, see Klasen and Wink (2001).

<sup>2</sup> Using a decomposition based on three groups (Europe, Female-Deficit Regions, and Remaining Countries), one can show that some 30% of the global rise between 1960 and 1995 is due to increases in the sex ratio in Europe, about 15% due to the increase in the sex ratio in female-deficit countries and the remaining 55% are due to the increase in the share of female-deficit countries among the world's population and the converse decline of European populations, where females outnumber males. The increase in the sex ratio in Europe is largely related to the falling demographic importance of the male cohorts that were heavily decimated during World War II.



Note: Female Deficit Regions include East Asia, West Asia, Southern Asia, and North Africa. See below  
 Source: United Nations (1999)

By now nearly all countries with considerable excess female mortality have conducted new censuses which allows us to see whether there indeed has been a worsening or an improvement. By examining the latest census returns and updating the number of ‘missing women’, we show that the number of missing women has continued to rise in absolute terms to some 65-107 million, depending on the assumptions used. In relative terms (as a share of women alive), it has, however, improved in most countries, regardless of the assumptions used. After significant improvements in Bangladesh and Pakistan, India now has the highest share of missing females. While improved female education and employment opportunities have generally reduced excess female mortality, the increased use of sex selective abortions has had the opposite effect of raising the number of missing women, particularly in China, but increasingly also in India.

## 2. The Concept and Measurement of Missing Women

While one way to assess the survival-disadvantage of females is to examine age-specific mortality patterns by sex, such data are often not available or reliable in many poor countries. Also, it may be of interest to examine the cumulative impact of past and present gender bias in mortality on the populations alive today.

Thus a second method to assess the impact of gender bias in mortality is to compare the actual population sex ratio (the number of males divided by the number of females at the most recent census) with an ‘expected’ population sex ratio that would obtain given equal treatment of the sexes in the distribution of survival-related goods. If the actual ratio exceeds

the expected, the additional number of women that would have to be alive to equate the actual with the expected sex ratio then is the number of ‘missing women’ at that point in time.<sup>3</sup>

It is based only on the population sex ratio which is likely to be the most reliable demographic figure in developing countries, as it ‘only’ requires an accurate census count but no accurate monitoring of vital statistics. Also, as a stock measure it allows an estimate of the cumulative impact of gender bias in mortality on the population alive today.<sup>4</sup>

The critical question in the calculation of the number of missing women is the expected sex ratio that would obtain in the absence of discrimination. Since no society in the world, past or present, has been entirely gender-neutral in the allocation of resources, opportunities, and behavioral patterns, it is quite difficult to speculate on the sex ratio in the absence of gender discrimination. For example, the high female survival advantage in European countries is not a sign of discrimination against males in the allocation of resources, but is, in part, related to male behavioral patterns, mainly smoking, drinking, dangerous driving, and a higher incidence of violence against oneself and others, that reduce their life expectancy considerably vis-à-vis females (Waldron, 1993).

In his illustrative calculations to get a sense of the enormity of the problem, Sen used simply the population sex ratio prevailing in Sub Saharan Africa as a benchmark (Sen, 1989; 1990, 1992).<sup>5</sup> This generated a total number of over 100 million missing women in the regions most affected by gender bias in mortality, which are South Asia, China, the Middle East, and North Africa (see Sen 1989, 1990; Klasen, 1994).

In a more precise demographic assessment of the phenomenon, the ‘expected sex ratio’ of a population is not a constant but instead depends on four factors (see Coale, 1991; Klasen,

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<sup>3</sup> By holding the number of men constant in that hypothetical calculation, the implicit assumption (as also in the other method) is that the number of women could be increased without correspondingly reducing the number of males. Since the distribution of survival-related goods is, at least in part, a zero-sum game, this assumption, it is not clear whether one could indeed increase the number of females without at least somewhat reducing the number of males.

<sup>4</sup> Clearly it is useful and important to rely on both approaches to corroborate one’s findings which we do below. Fortunately, there is close correspondence between sex ratios and sex specific mortality rates so that both statistics tell essentially the same story. See also Coale (1991).

<sup>5</sup> It turns out, however, that the demographic conditions in Sub Saharan Africa are quite different from Asia and the Middle East in three ways. First, fertility is much higher which leads to a very different age structure with implications for the population sex ratio (see below). Second, mortality is also higher which also impacts the expected mortality experience of males and females differently. And third, African populations have a slightly, but significantly lower sex ratio at birth than other populations which is part of the reason of its comparatively low population sex ratio (see Coale 1991 and Klasen 1994 for details). In some publications (Sen, 1990a) he also used the sex ratio prevailing in rich countries of 1.05 as an alternative benchmark. This benchmark is more problematic than Sub Saharan Africa for three reasons as was pointed out by Coale (1991). First, the high sex ratio in Europe is partly the result of World War II which heavily decimated male cohorts. Second, and of increasing importance, is the large share of elderly among the population compared to developing countries. Since women predominate among the elderly (see below), a large share of the elderly boost the sex ratio beyond the levels one would expect in the young societies of developing countries (see also below). Third, the behavioral

1994): First, the sex ratio at birth which differs from parity but suggests a slight male excess in all populations. Viewed in isolation, this would suggest an expected population sex ratio favoring males. Although Coale (1991) suggested that the excess of males at birth is constant, evidence from the biomedical literature, long time series from developed countries as well as cross-analyses from today's world all suggest that the sex ratio at birth rises with overall health conditions.<sup>6</sup> Table 1 shows regressions predicting the sex ratio at birth in a cross-section of countries, based on overall health conditions which is proxied by life expectancy at birth. The data are based on sex ratios at birth reported in the Demographic Yearbooks of the last 20 years. Countries included in the sample must have complete birth registration, at least 5000 births per year, no evidence of sex-selective abortions, and, in the first regression, must not contain a significant portion of African populations, as it has been shown that African populations (and populations of African descent in the Caribbean and the US) have a significantly lower sex ratio at birth.<sup>7</sup> The regressions in columns 2 and 3 are then done for countries where Africans form the vast majority as well as for African-Americans in the USA at different points in time. Regression four then combines all the data and just uses a dummy variable for African populations.

Column 1 shows indeed a significant positive relationship between the two variables and suggests that 10 years of greater longevity are associated with a 0.9 percentage point higher sex ratio at birth.<sup>8</sup>

Column 2 shows the regressions for countries with African populations (from Africa, the Caribbean, and African-Americans in the US). As expected, we see a lower level of the sex ratio at birth (constant) but also a much stronger influence of life expectancy on the sex ratio at birth. If we restrict the sample to African-Americans in the US at 11 points in time

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patterns that lead to high mortality among males (compared to females) are particularly prevalent in rich countries where men, due to their greater prosperity, have greater access to cars, cigarettes, and alcohol.

<sup>6</sup> There is a large literature documenting that the sex ratio *in utero* is considerably higher than at birth, and that the sex ratio of miscarriages, spontaneous abortions, and stillbirths is much larger than the sex ratio at birth. As a result, improving health conditions that reduce the incidence of miscarriages and stillbirths will then increase the sex ratio at birth which is consistent with the secular trends in the sex ratio at birth. For a detailed discussion see Klasen (1994) and Chanazarian (1986). Whenever better health and nutrition lowers the rates of such spontaneous abortions and miscarriages and reduces the incidence of stillbirths, the sex ratio at birth will consequently increase.

<sup>7</sup> This is not only apparent from data on sex ratios at birth in Africa, but also from Africans in the US and the Caribbean and has been well-documented (e.g. Teitelbaum 1970, Teitelbaum and Mantel 1971; Chanazarian, 1986; James, 1986, Khoury et al, 1983). For a more detailed discussion, see Klasen (1994). While it is likely that sex ratios at birth in other regions of the world are not uniform but also differ slightly and that, due to the high genetic diversity of Africa, the sex ratio at birth is likely to differ within Africa, these differences have not been found to be so large that they can be detected with some certainty in available demographic data.

<sup>8</sup> Klasen (1994) produced a regressions based on only 62 observations (all of which are contained in the augmented analysis here) with nearly identical results. See Klasen and Wink (2001) for more details.

(from the 1940 to 1988), the impact of longevity is smaller and more similar to the other regions, but the difference in the level of the sex ratio at birth prevails.

The fourth regression pools the data from the non-African and African populations. Life expectancy continues to exert a significant influence on the sex ratio at birth with the coefficient being about half-way between the non-African and the African regressions. Also, the dummy for African populations again shows the lower sex ratio at birth of some 1.6 percentage points prevailing among them, even if one controls for the influence of life expectancy.

**Table 1 Life Expectancy and the Sex Ratio at Birth**

Sample	(1) Non-African	(2) African	(3) Just African- Americans	(4) All Combined
Constant	0.991 (64.61)***	0.888 (21.51)***	0.982 (69.14)***	0.957 (64.61)***
Life Expectancy	0.00087 (4.14)***	0.00216 (3.35)**	0.00070 (3.07)*	0.00134 (6.35)***
African Population (dummy)				-0.0157 (4.17)***
Adj. R-Squared	0.071	0.254	0.458	0.326
N	212	31	11	243

Sources: United Nations (1987, 1993, 1999, 1984), US Department of Health and Human Services 1991. \*\*\* refers to 99.9% significance, \*\* to 99%, and \* to 95% significance levels.

Clearly, the sex ratio at birth has to be considered in calculating the expected population sex ratio and its relationship to overall health conditions has to be taken into account.

Second, the sex ratio depends on the expected sex specific mortality rates that would exist in a non-discriminating society. Coale (1991) suggested using the Princeton Model Life Tables as the benchmark for non-discriminating societies. The Model Life Tables are made up of some 240 life tables from all parts of the world (but with a heavy predominance from Europe) dating largely from mid- 19<sup>th</sup> century up until the mid 20<sup>th</sup> century (Coale, Demeny, and Vaughan, 1983). They are aggregated into four regional groupings ('West', 'East', 'North', and 'South') based on observed differences in the patterns of mortality, esp. the relationship between childhood and adult mortality rates, and then calculated for different mortality levels assuming stable populations (see Coale, Demeny, and Vaughan, 1993 for details).<sup>9</sup> Although the populations that make up these model life tables were also not gender neutral in all respects, from a demographic point of view they are likely to approximate sex-specific mortality rates in non-discriminating societies more closely than most other possible

<sup>9</sup> Stable populations are populations that exhibit constant fertility and mortality rates and thus a constant age structure of the population. The Model Life Tables can also be used for 'quasi-stable' populations that exhibit constant fertility but uniformly declining mortality levels as such populations also generate a stable age structure. See Coale, Demeny, and Vaughan (1983), Coale (1991), and discussion below.



assumptions. In particular, the behavioral patterns leading to high excess male deaths in today's societies (relating to traffic accidents and smoking) were not widespread, the incidence of reported gender bias in mortality is generally low (especially when compared to today's episodes, Klasen, 1999), and maternal mortality rates, which could distort expected mortality patterns, were no longer very high and actually quite comparable to some of today's developing regions.

All four sets of Model Life Tables show a considerable female survival advantage in infancy and in older age groups (particularly above age 50). In-between, women only enjoy a survival advantage in moderate to low mortality environments; in high mortality environments (with female life expectancy below 40), girls suffer from higher mortality than boys, particularly in the Tables 'West' and 'South', while adult women in high mortality environments additionally suffer from slightly higher mortality than men of the same age in the 'East' and 'South' Tables.<sup>10</sup> In the 'North' tables, based on the mortality experience of Scandinavian countries, this female disadvantage is generally the smallest. While Coale (1991) relied on the Model Life Tables 'West' in his assessment, Klasen (1994) suggested that these Tables were underestimating gender bias in mortality, particularly in high mortality environments, as the countries that formed the basis for those Model Life Tables themselves had experienced episodes of moderate excess female mortality, particularly in the 19th century. This was shown by finding that the Model Life Tables 'West' assumed that girls between 1-20 have higher mortality rates than boys in high mortality environments which is contrary to the biological evidence and likely to be related to actual episodes of gender bias in mortality in the 19th century (e.g. Klasen, 1998; Humphries, 1991; Klasen, 1999, McNay, Humphries, and Klasen, 1998). Instead he suggested to use the Model Life Tables 'East' for his preferred estimate.

Using any of the Model Life Tables would imply that over the life cycle, men will suffer from higher mortality rates than females, particularly in infancy and old age which accords well with the biological literature on the subject (see Waldron, 1983, 1993; 1998). As a result, we would expect that the male excess at birth is progressively eroded as people age. In high mortality environments, parity between males and females of a cohort is expected to be achieved by the age 10-20; in low mortality environments, it is only achieved after age 50.

This combination of a male excess among the young and a female excess among the old (and the middle-aged, depending on the overall mortality environment), clearly implies that the age structure of the population, which is largely driven by fertility patterns, will have

an impact on the expected sex ratio. The population growth rate and the resulting age structure is therefore the third factor that influences the expected sex ratio of a population. Countries experiencing high population growth and thus a large share of young people have a higher expected sex ratio than populations with low fertility and thus a larger share of the elderly.

Lastly, the expected sex ratio might be influenced by international migration if such migration is unbalanced in its gender make-up. While there is significant migration taking place involving the countries that experience ‘missing women’ problems, this does not have a large effect on the ‘missing women’ calculation and was, also in view of the paucity of reliable data to factor in this effect, therefore not considered by Sen (1989), Coale (1991), or Klasen (1994).<sup>11</sup>

Based on the Model Life Tables ‘East’ for the mortality level and population growth prevailing in the early 1970s<sup>12</sup>, and a sex ratio at birth predicted by regression 1 in Table 1, the left-hand panel of Table 2 shows the number of missing women in the 1980s and early 1990s in the countries most affected by gender bias in mortality. These figures differ slightly from Klasen (1994) due to final adjustments made to preliminary census returns in China, India, and Egypt that had been used in Coale (1991) and Klasen (1994),<sup>13</sup> and slight differences due

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<sup>10</sup> On the other hand, women’s survival advantage in infancy and older ages is larger in the ‘East’ tables which consequently generates the highest number of implied ‘missing women’ below.

<sup>11</sup> The most important migrant flows that could potentially affect sex ratios are from South Asia to the Middle East and North Africa, particularly to the oil-rich Arab States and, to a smaller degree, from Egypt to the oil-rich Arab States. These migrant flows have been considerable, particularly in the 1970s and males tended to predominate. As a consequence they contribute to increasing sex ratios in the receiving countries, particularly Saudi Arabia, Kuwait, UAE, Oman, Qatar, and Libya. But the male excess in these migrant flows, as a share of the sending countries’ populations (particularly India, Bangladesh, and Pakistan) is quite small given the huge populations of these countries. For example, Kuwait, an important destination for migrants in the 1970s and early 1980s had a sex ratio of 1.32, clearly above what one would expect. Among natives, the sex ratio was 0.99 while among the foreign born population it was a staggering 1.61 showing the male bias of immigration. But the excess of males among the foreign born population, which mostly originated from Egypt, Bangladesh, India, and Palestinians was a mere 0.3 million thus hardly affecting the sex ratios in the sending countries with a combined population of some 900 million at the time (United Nations, 1991). Also, these flows have generally stagnated or gotten smaller in recent years, partly as a result of falling oil prices in the 1980s and 1990s, and partly in the aftermath of the Gulf War. Ignoring these flows would therefore slightly underestimate the number of ‘missing women’ in South Asia and Egypt (as the actual sex ratio is, due to male-dominated migration, artificially smaller and thus reduces the implied number of ‘missing women’). Conversely, it may increase the implied number of ‘missing women’ in West Asia, the most important receiving region.

<sup>12</sup> The statistics in the Model Life Tables are calculated for stable or so-called ‘quasi-stable’ populations which exhibit constant fertility and uniformly declining mortality levels that would also yield a stable age structure. To adjust for the fact that most not only have falling mortality but also falling fertility levels, Coale (1991) did not take the fertility levels of the time of the census but those prevailing some 20 years earlier to generate roughly average fertility levels for the cohorts alive at the census time. We also adopt this approach. See below for a discussion of this assumption.

<sup>13</sup> Most notably was the downward revision of the sex ratio in China from 1.066 to 1.060 which thereby reduced the number of missing women by some 3.3 million (regardless of the assumption used to generate the expected sex ratio). In contrast, revisions to the figure from India and Egypt decreased the number of missing women by 0.9 million and 0.1, respectively.

to the expanded regression predicting the sex ratio at birth.<sup>14</sup> The set of countries considered has also been expanded to include other regions and countries where gender bias in mortality might be a problem.<sup>15</sup> The countries considered by Sen, Coale, and Klasen in the earlier publications are shown in bold and a total is reported for just those regions (called ‘total comparable’).

When considering the countries included by Sen, Coale, and Klasen, the total number of missing women for the 1980s and early 1990s, using our preferred estimation methodology, stands at 86.8 million. When using Sen’s assumption of the expected sex ratio prevailing in Sub Saharan Africa, the number increased to 102 million; using Coale’s assumption of the Model Life Tables ‘West’ and a fixed sex ratio at birth, the number drops to some 58 million.<sup>16</sup> Due particularly to adjustments in the final census counts, India has the highest absolute number of missing women in the early 1990s which is in contrast to earlier estimates by Sen, Coale, and Klasen who all found a larger number of missing women in China.<sup>17</sup> Among the countries considered in earlier studies, the largest relative problem, indicated by the share of females that are missing, appears to be in Pakistan, followed closely by Bangladesh, and India, while more moderate problems exist in West Asia, Nepal, China, and Egypt.

The additional countries considered also show a considerably number of missing women, bringing the total number of missing women to some 96 million. Particularly noteworthy are the considerable problems of missing women in Afghanistan and Taiwan, while more moderate problems appear in Sri Lanka, Iran, Tunisia, and Algeria. In Sub Saharan Africa there also appeared to have been a slight problem of missing women, which is

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<sup>14</sup> Moreover, the mortality assumption for Bangladesh in the early 1970s was changed as was the actual sex ratio in West Asia which was erroneously reported to be 1.060 in Coale (1991) and, by implication, Klasen (1994). The sex ratio reported in the source given is 1.073 (United Nations, 1991).

<sup>15</sup> We also show the data for Turkey and Syria, two countries that are subsumed under the West Asia region. They are not counted in the totals.

<sup>16</sup> As argued above, both sets of assumptions are, for different reasons, problematic. In Coale (1991), the number reported was 60 million, in Klasen (1994) the number reported using Sen’s procedure was 107 million. The differences are mostly due to revised census counts.

<sup>17</sup> This is not the case if one used Sen’s assumption but is the case using Coale’s.

not as readily apparent due to the lower sex ratio at birth prevailing there, but which is consistent with mortality statistics from the region (see Klasen, 1996).

Table 3: Number of Missing Women, latest estimate (based on Model Life Tables 'East' and adjusted sex ratio at birth)

Estimate for 1980s and early 1990s							New Estimate based on Most Recent Censuses and Demographic Estimates							
Year	Actual Number of Women	Actual Sex Ratio	Expected Sex Ratio	Missing Women	%Missing	Year	Actual Number of Women	Actual Sex Ratio	Expected Sex Ratio at Birth	Expected Sex Ratio	Expected Number of Women	Missing Women	%Missing	
<b>China</b>	<b>1990</b>	<b>548.7</b>	<b>1.060</b>	<b>0.997</b>	<b>34.6</b>	<b>6.3%</b>	<b>2000</b>	<b>612.3</b>	<b>1.067</b>	<b>1.050</b>	<b>1.001</b>	<b>653.2</b>	<b>40.9</b>	<b>6.7%</b>
Taiwan	1990	9.8	1.071	0.998	0.7	7.3%	1999	10.8	1.049	1.052	1.002	11.3	0.5	4.7%
South Korea	1985	20.2	1.002	1.003	-0.0	-0.1%	1995	22.2	1.008	1.047	1.000	22.4	0.2	0.7%
<b>India</b>	<b>1991</b>	<b>407.1</b>	<b>1.079</b>	<b>0.986</b>	<b>38.4</b>	<b>9.4%</b>	<b>2001</b>	<b>495.7</b>	<b>1.072</b>	<b>1.037</b>	<b>0.992</b>	<b>535.7</b>	<b>40.0</b>	<b>8.1%</b>
<b>Pakistan</b>	<b>1981</b>	<b>40.0</b>	<b>1.105</b>	<b>0.998</b>	<b>4.3</b>	<b>10.8%</b>	<b>1998</b>	<b>62.7</b>	<b>1.081</b>	<b>1.042</b>	<b>1.003</b>	<b>67.6</b>	<b>4.9</b>	<b>7.8%</b>
<b>Bangladesh</b>	<b>1981</b>	<b>42.2</b>	<b>1.064</b>	<b>0.977</b>	<b>4.6</b>	<b>8.9%</b>	<b>1991</b>	<b>54.1</b>	<b>1.059</b>	<b>1.038</b>	<b>0.991</b>	<b>57.9</b>	<b>3.7</b>	<b>6.9%</b>
<b>Nepal</b>	<b>1981</b>	<b>7.3</b>	<b>1.050</b>	<b>0.975</b>	<b>0.6</b>	<b>7.7%</b>	<b>1991</b>	<b>9.3</b>	<b>0.995</b>	<b>1.035</b>	<b>0.994</b>	<b>9.3</b>	<b>0.0</b>	<b>0.1%</b>
Sri Lanka	1981	7.3	1.040	1.005	0.3	3.4%	1991	8.6	1.005	1.052	1.006	8.6	0.0	0.0%
<b>West Asia</b>	<b>1985</b>	<b>55.0</b>	<b>1.073</b>	<b>1.002</b>	<b>3.9</b>	<b>7.1%</b>	<b>2000</b>	<b>92.0</b>	<b>1.043</b>	<b>1.042</b>	<b>1.002</b>	<b>95.8</b>	<b>3.8</b>	<b>4.2%</b>
of which: Turkey	1985	25.0	1.027	0.996	0.8	3.2%	1990	27.9	1.027	1.047	1.003	28.5	0.7	2.4%
Syria	1981	7.3	1.050	1.000	0.4	5.0%	1994	6.7	1.047	1.048	1.016	6.9	0.2	3.1%
Afghanistan	1979	6.3	1.059	0.965	0.6	9.7%	2000	11.1	1.054	1.024	0.976	12.0	0.9	8.0%
Iran	1986	24.2	1.046	1.001	1.1	4.5%	1996	29.5	1.033	1.039	1.030	29.6	0.1	0.2%
<b>Egypt</b>	<b>1986</b>	<b>23.5</b>	<b>1.049</b>	<b>0.998</b>	<b>1.2</b>	<b>5.1%</b>	<b>1996</b>	<b>29.0</b>	<b>1.048</b>	<b>1.044</b>	<b>1.003</b>	<b>30.3</b>	<b>1.3</b>	<b>4.5%</b>
Algeria	1987	11.3	1.024	0.997	0.3	2.7%	1998	14.5	1.018	1.043	1.005	14.7	0.2	1.2%
Tunisia	1984	3.4	1.038	0.993	0.2	4.5%	1994	4.3	1.021	1.043	1.000	4.4	0.1	2.1%
Sub-Saharan Africa	1990	253	0.980	0.962	4.9	1.9%	2000	307.0	0.987	0.995	0.961	315.4	8.4	2.7%
<b>Total (Comparable)</b>		<b>1123.9</b>			<b>86.8</b>	<b>7.7%</b>		<b>1355.1</b>				<b>94.7</b>	<b>7.0%</b>	
Total (World)		1491.7			95.9	6.4%		1456.1				106.2	6.0%	

Note: Total Comparable includes China, India, Pakistan, Bangladesh, Nepal, West Asia, and Egypt. Total World additionally includes Taiwan, South Korea, Iran, Algeria, Tunisia, and Afghanistan. Turkey and Syria are subsumed in West Asia and thus not added separately. The expected sex ratio at birth is based on regression 1 in Table 1 (regression 2 for Sub-Saharan Africa).

Sources: Registrar General (2001), United Nations (1999, 2000); State Statistical Bureau (2001), Statistical Bureau of Taiwan (2001).

#### 4. An Update on the Number of Missing Women

Based on the same assumptions of our preferred methodology, but more recent demographic information, the right-hand panel of Table 2 shows estimates of the number of missing females in the world.

Beginning with the global figure, the comparable figure shows an increase in the number of missing women from 87 million to 95 million. Thus the cumulative impact of gender bias in mortality is exacting an increasing absolute toll on women worldwide. While this points to an *absolute* worsening, it suggests a slight *relative* improvement. The population in the countries suffering from excess female mortality increased by some 18% while the number of missing women increased by ‘only’ about 8%. Thus gender bias in mortality has not increased in proportion with population suggesting that, as a share of the female population, females now have slightly less unequal survival chances vis-a-vis males. This can also be seen in the share of missing women in the various countries considered. Compared to the left-hand panel of Table 2, it has decreased in most regions, although the extent of the drop differs greatly between regions. In all regions combined, the share of missing women has fallen from 7.7% to 7%.

The largest drop, in percentage terms, occurred in Nepal, where results from the 1991 census suggest that the problem of missing women has all but disappeared. This sudden drop of the sex ratio is, as will be shown below, not very plausible so that this result should be treated with some caution. The drop, in percentage terms, is also considerable in Bangladesh and Pakistan, where the share of missing women dropped by 4-5 percentage points. The fall is more modest in India, West Asia, and Egypt where it dropped by some 1-2 percentage points. In China, the relative drop is smallest of all, a mere 0.8 percentage points. As a result of the considerable improvements in Pakistan and Bangladesh, India now has the dubious distinction of having the largest share of missing women in the world.

Similar trends also exist in the expanded set of countries considered. While there has been an increase in the total number of missing women from 96 million to 106 million, the share of missing women fell from 6.4% to 6%. The absolute number of missing women fell in most countries and in virtually all countries there has been a significant reduction in the share of missing women. Particularly noteworthy is the virtual disappearance of the phenomenon in Sri Lanka (see below), and great improvements in Taiwan and in Iran, although there may be confounding factors in the latter country (see below). In Afghanistan, the problem persists at a high level but non-existing demographic information which is substituted by estimated from the United Nations makes any guesses on the actual trends

hazardous. It is likely that the anti-female policies adopted by the ruling Taliban government, which includes a prohibition on female education and employment as well as much worse health services for women, has worsened the situation considerably.<sup>18</sup>

Two exceptions to the general relative improvements are South Korea and Sub-Saharan Africa. In the former country, there has been a slight worsening from no missing women at all in 1985 to a slight problem in 1995. In Sub-Saharan Africa, the already existing slight problem of missing women has worsened somewhat and this is contributing heavily to the absolute increase in the global number of missing women (see Klasen, 1994; 1996). This conclusion is, however, quite sensitive to the assumption about the sex ratio at birth.<sup>19</sup>

When examining the factors underlying this relative improvement, one can distinguish between changes in the expected sex ratio and changes in the actual sex ratio. With the exception of South Korea, the expected sex ratio has increased in all other countries included. The main reason for this is the increase in the expected sex ratio at birth due to improved longevity in these countries. In other words, due to this effect, we would have expected sex ratios to increase in most parts of the world. The higher longevity has a second effect on the expected sex ratio. In populations that are growing and thus have a large share of young people, expanded longevity actually increases the expected sex ratio at birth as males benefit relatively more from an equiproportionate mortality decline as the male excess at birth now survives to higher ages and males have higher mortality rates to begin with. Conversely, falling population growth rates in some (though not all) regions would have also reduced the expected sex ratio at birth as the populations would age and thus females would predominate more. Since the expected sex ratios increased everywhere except in South Korea, the first two effects dominate the third.

What, however, happened to actual sex ratios? With the exception of China, South Korea, and Sub-Saharan Africa where it increased slightly, it has fallen in all other regions. The decreases vary considerably. The largest decrease (which appears implausible) was in Nepal, but there were also substantial decreases in Pakistan, Bangladesh, and West Asia. In Egypt and India the decreases were slight.<sup>20</sup> In countries that were not included in Coale (1991), and Klasen (1994), most have also experienced decreases in their sex ratio. In Iran,

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<sup>18</sup> On the other hand, continual warfare over the past 20 years will have exacted a heavy and likely male-dominated toll which will further distort the calculation of missing women.

<sup>19</sup> If we used regression 3 instead of regression 2 for the expected sex ratio at birth, the number of missing women would drop to some 1.5 million. Clearly, more research and accurate data on the sex ratio at birth in African populations is needed to resolve this large difference.

<sup>20</sup> The decrease in India might be merely due to a more accurate count of females in 2001, compared to 1991 (Dyson, 2001), in which case the high sex ratio in 1991 and the resulting number of missing females was somewhat overestimated (see also below). In any case, we no longer see a worsening in the sex ratio in India.

Turkey, Syria, Tunisia, Taiwan, and Algeria there were reductions in the sex ratio of varying degrees. The largest drop was experienced in Sri Lanka where the sex ratio dropped from 1.040 in 1981 to an estimated 1.005 in 1991 (Klasen, 2001).<sup>21</sup>

Had gender bias in mortality remained constant in relative terms, we would have expected rising sex ratios in all regions except South Korea. Combined with population growth, this would have led to drastically rising numbers of missing women. In reality, the actual sex ratios dropped in most regions and these two factors combined are responsible for the slightly more favorable relative picture, although the existing population growth ensured that the absolute number of missing women increased in all countries except Bangladesh, Nepal, and Sri Lanka.

### 3. Sensitivity Analysis

Table 3 shows a sensitivity analysis on the number of missing women using four alternative calculations. They are not only designed to show some other plausible alternative estimates, but also the impact of the various factors associated with the calculation of the expected sex ratio. Column 1 reproduces the figures from Table 3, our preferred estimates. Columns two and three only change the Model Life Tables to 'West' and 'North'. As can be seen, the choice of Model Life Tables has a moderate impact on the estimated number of missing women. Using the West Tables, the number of missing women is some 10 million lower, while the North Tables show a number of some 5 million fewer missing women.

Column 4 shows the impact if we chose (inappropriately, as we have argued above) a constant sex ratio at birth of 1.059 as done in Coale (1991). The number of missing women would drop by some 44 million, and 30 million on a comparable basis to Coale (1991).<sup>22</sup>

Column 5 shows the impact of using Sen's assumption by using Sub Saharan Africa's current sex ratio as the benchmark (which we also believe to be a problematic assumption as suggested above). Since the sex ratio in Sub Saharan Africa has been increasing, this benchmark yields no longer numbers that are much greater than the estimates presented here. It estimates that there are some 114 million missing women, and the increase in the number of missing women is the smallest (in absolute and relative terms) when this assumption is used.

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<sup>21</sup> In, the heavy and predominantly male losses during the Iran-Iraq War might partly contribute to the fall in the sex ratio. Some of these losses should already have been apparent in 1986 which suggests that the number of 'missing females' is underestimated in both census counts.

<sup>22</sup> Note that the difference between this assumption and the preferred estimate proposed here is slightly smaller in relative terms than it was in Klasen (1994) where the preferred estimate increased the number of missing women by some 50%. This is due to the fact that the assumption of a constant sex ratio would, by definition, exclude the increase in the expected sex ratio at birth that is partly driving the somewhat smaller relative female disadvantage.



While this sensitivity analysis shows that the assumptions underlying the calculation significantly influence the absolute number of missing women, all methodologies agree on a rising absolute number and a falling relative number of missing women in the world. They also agree on the countries with the worst problems, particularly India, China, Pakistan, Bangladesh, and Afghanistan, while there is some disagreement as to the existence and extent of the problem in some of the countries that are least affected.

Apart from these assumptions, one may also query whether the assumption of a quasi-stable population inherent in all estimates (except Sen's) is still appropriate in some of the countries. Clearly, the age structure in China, but also India, South Korea, Taiwan, and most North African countries is changing rapidly as low fertility rates generate an increasingly aged population. Ignoring this effect would potentially underestimate the number of missing women as the falling birth rates hit particularly the young cohorts and, as they are more male-dominated, should reduce the true expected sex ratio of a population and thus increase the number of missing women. As we have used the demographic conditions (esp. population growth and mortality conditions) from the early 1980s rather than the current ones, we have tried to minimize this bias.<sup>23</sup>

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<sup>23</sup> Without exact data on the age structure of the populations and precise fertility rates for the past 30 years, it is impossible to fully address this problem.

Table 4: The Number of Missing Women using Alternative Assumptions.

	(1)		(2)		(3)		(4)		(5)	
	Preferred Estimate		West and Adj. Sex Ratio at Birth		North and Adj. Sex Ratio at Birth		West Fixed Sex Ratio at Birth		Sen New Sex Ratio for Sub-Sah. Africa	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
<b>China</b>	<b>40.9</b>	<b>6.7%</b>	<b>37.8</b>	<b>6.2%</b>	<b>36.0</b>	<b>5.9%</b>	<b>32.3</b>	<b>5.3%</b>	<b>49.9</b>	<b>8.2%</b>
Taiwan	0.5	4.7%	0.4	3.9%	0.4	3.7%	0.3	3.2%	0.7	6.3%
South Korea	0.2	0.7%	0.0	0.1%	0.0	0.1%	-0.2	-1.0%	0.5	2.1%
<b>India</b>	<b>40.0</b>	<b>8.1%</b>	<b>35.6</b>	<b>7.2%</b>	<b>38.7</b>	<b>7.8%</b>	<b>24.6</b>	<b>5.0%</b>	<b>42.6</b>	<b>8.6%</b>
<b>Pakistan</b>	<b>4.9</b>	<b>7.8%</b>	<b>4.5</b>	<b>7.2%</b>	<b>4.7</b>	<b>7.5%</b>	<b>3.4</b>	<b>5.5%</b>	<b>6.0</b>	<b>9.6%</b>
<b>Bangladesh</b>	<b>3.7</b>	<b>6.9%</b>	<b>3.2</b>	<b>6.0%</b>	<b>3.6</b>	<b>6.6%</b>	<b>2.1</b>	<b>3.9%</b>	<b>3.9</b>	<b>7.3%</b>
<b>Nepal</b>	<b>0.0</b>	<b>0.1%</b>	<b>-0.1</b>	<b>-0.9%</b>	<b>0.0</b>	<b>-0.2%</b>	<b>-0.3</b>	<b>-3.1%</b>	<b>0.1</b>	<b>0.8%</b>
Sri Lanka	0.0	0.0%	-0.1	-0.7%	-0.1	-0.9%	-0.1	-1.4%	0.2	1.9%
<b>West Asia</b>	<b>3.8</b>	<b>4.2%</b>	<b>3.3</b>	<b>3.6%</b>	<b>3.6</b>	<b>3.9%</b>	<b>1.8</b>	<b>2.0%</b>	<b>5.3</b>	<b>5.7%</b>
Turkey	0.7	2.4%	0.5	1.9%	0.6	2.0%	0.2	0.7%	1.1	4.0%
Syria	0.2	3.1%	0.3	5.1%	0.2	2.7%	0.3	4.0%	0.4	6.1%
Afghanistan	0.9	8.0%	0.9	8.0%	1.0	9.1%	0.5	4.4%	0.7	6.8%
Iran	0.1	0.2%	0.8	2.8%	1.0	3.4%	0.3	0.9%	1.4	4.7%
<b>Egypt</b>	<b>1.3</b>	<b>4.5%</b>	<b>1.1</b>	<b>3.9%</b>	<b>1.2</b>	<b>4.1%</b>	<b>0.7</b>	<b>2.4%</b>	<b>1.8</b>	<b>6.2%</b>
Algeria	0.2	1.2%	0.1	0.7%	0.1	1.0%	-0.1	-0.8%	0.5	3.1%
Tunisia	0.1	2.1%	0.1	1.6%	0.1	1.7%	0.0	0.0%	0.2	3.5%
Sub-Saharan Africa	8.4	2.7%	8.4	2.7%	10.8	3.5%	-3.6	-1.2%	0.0	0.0%
<b>Total (Comparable)</b>	<b>94.7</b>	<b>7.0%</b>	<b>85.5</b>	<b>6.3%</b>	<b>87.7</b>	<b>6.5%</b>	<b>64.7</b>	<b>4.8%</b>	<b>109.5</b>	<b>8.1%</b>
Total (World)	106.2	6.0%	96.6	5.5%	101.3	5.7%	62.2	3.5%	113.8	6.5%

Note: For West and a fixed sex ratio at birth (column 4), a sex ratio of 1.059 is assumed for all countries except Sub Saharan Africa while a sex ratio of 1.034 is assumed for Sub Saharan Africa.

#### **4. Explaining Trends in Gender Bias in Mortality**

From the Tables in the last section, we can generate the following stylized facts regarding trends in gender bias in mortality. While in absolute terms, the number of missing women has increased, in relative terms it is falling in most places. Particularly sharp reductions, in relative terms, occurred in North Africa, and parts of South Asia, most notably Nepal, Bangladesh, and Pakistan (from very high levels). In Sri Lanka, it entirely disappeared and in India it has been slightly reduced. China has experienced the least reduction of all. South Korea and Sub Saharan Africa experienced a deterioration. What factors are driving this trend towards such an uneven relative improvement?

Before discussing this it is important to briefly review the most important findings on both the mechanisms and the causal factors associated with excess female mortality. Most studies have shown that the most important process driving excess female mortality is unequal access to health care which is leading to higher mortality of young girls (e.g. Chen et al., 1981; Alderman and Gertler, 1997; Croll, 2000; Basu, 1992, Klasen, 1999; Timaeus, Harris, and Fairbain, 1999), while differences in access to nutrition appear to be smaller (e.g. Chen et al. 1981; Sommerfelt and Arnold, 1999, Basu, 1992; Hill and Upchurch).

This comparative neglect of female children, which is generally worse in rural areas, appears to be particularly severe for later-born girls and among them even worse for girls with elder sisters (Das Gupta, 1987; Muhuri and Preston, 1991, Klasen, 1999, Dreze and Sen, 1995).

In addition, sex selective abortions seems to have played an increasing role in some countries experiencing missing women, most notably China, South Korea, and possibly India (Croll, 2000; Banister and Coale, 1994; Registrar General 2001). The most important evidence of this is the rising observed sex ratios at birth which appear to be indeed due largely to sex-selective abortions rather than the underregistration of female infants (Croll, 2000; Banister and Coale, 1994).

While these appear to be the most important processes generating gender bias in mortality, there is now an increasing literature on the most important underlying causes of this neglect of female children. Cross-sectional evidence suggests that high sex ratios and high relative female mortality are associated with low female employment opportunities (e.g. Rosenzweig and Schultz, 1982; Murthi, Guio, and Dreze, 1995; Klasen, 2001; Sen, 1990a). In addition, higher female education appears to lower excess female mortality, although the effects of this appear to be non-linear (World Bank, 2001; Murthi, Guio, and Dreze, 1995; Das Gupta, 1987; Dreze and Sen, 1995).

Apart from these factors associated with female empowerment, there are a number of customs and cultural practices that appear to be hurt females in some regions. Among them are virilocal marriage patterns, great importance attached to ancestry worship undertaken by sons, high dowry payments for brides, and processes of emulating upper strata of society (e.g. Dyson and Moore, 1983; Dreze and Sen, 1995; Croll, 2000).

Also, it appears that scarcity of economic resources is a necessary, but not sufficient condition for gender bias in mortality. While it must be the case that households are forced to ration scarce resources allocated to nutrition and health care for the differential treatment of girls to emerge, in many countries the poorest sections of the population experience less gender bias in mortality than slightly richer groups (e.g. Murthi, Guio, and Dreze, 1995; Klasen, 1999, 2001, Dreze and Sen, 1995), which is presumably related to greater female economic independence and less strict cultural strictures among the poorest sections of the population.

Lastly, state policy can critically influence gender bias in mortality. To the extent that the state provides free access to nutrition and health care, the need to ration scarce household resources is lessened which can help disadvantaged girls particularly. Similarly, state activism in the field of female education and employment can improve the situation of girl children. Conversely, strict family planning policies such as the one-child policy in China can heighten discriminatory practices as couples will try to ensure that their registered and surviving child is a boy.<sup>24</sup>

In Table 4, we present some regression results to illustrate some of the findings from above. The first regression tries to explain the percentage of missing women in an international panel with 47 observations. The observations include all countries and periods listed in Tables 2 and 3<sup>25</sup>, augmented by another 16 observations (two per country) from the most populous countries in Latin America and South-East Asia. As these regions do not have significant problems of gender bias in mortality, their inclusion should add variation to be explained and thus allow a more precise estimate of the effects of the various exogenous factors on the incidence of missing women.<sup>26</sup> The regression shows a strong negative influence of female literacy on the share of missing women. Higher female literacy thus has a sizeable influence on reducing gender bias in mortality. Female labor force participation also reduces gender bias in mortality although the effect is not significant. This particular result

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<sup>24</sup> see Klasen (1999) for a more detailed development of these arguments.

<sup>25</sup> The 1991 observations for Nepal is deleted as it appears not to be reliable. See discussion below.

<sup>26</sup> The results are, however, robust to the exclusion of these Latin American (Brazil, Mexico, Colombia, and Argentina) and South East Asian (Indonesia, Thailand, Malaysia, and the Philippines) countries.

should be treated with some caution as the data base for female labor force participation (ILO, 2000) is very weak and data quality and comparability across countries is likely to be a serious problem. Moreover, not all types of female labor force participation appear to help women to the same extent (see also Berik and Bilginsoy, 2000). In particular, the relatively high observed female labor force participation in East Asia does not appear to help women there as shown by the interaction term. Apart from measurement issues, one interpretation is that other factors that lead to significant gender bias in mortality dominate the effect of female labor force participation there (Croll, 2000). The large and significant regional dummy variables show that female labor force participation and female literacy is unable to explain all of the variation in gender bias in mortality; these influences are largely related to state policy as well as some of the customs and cultural practices that were described above. The time trend variable suggests a slight, but insignificant improvement between the first and second observation from each country.

Regressions two and three analyze the large inter-state variation in sex ratios in India.<sup>27</sup> We present two panel regressions here. The first is estimating a more complete model predicting the sex ratio of India's largest states.<sup>28</sup> For this model we only have data for 1971 to 1991. The second model is more restricted but allows us to include 1961 and 2001 in the panel data analysis.<sup>29</sup> A number of interesting results emerge. Second, reduced fertility does not appear to influence the sex ratio as was feared by some authors (e.g. Das Gupta and Mari Bhat, 1997). Third, there remain sizable regional variations captured by the dummy variables. They are likely to be related to cultural practices as well as state policies that dramatically differ regionally in India (e.g. Dreze and Sen, 1995; Dyson and Moore, 1983). Lastly, in contrast to the global regression, there appears to be a time trend suggesting worsening sex ratios. This may partly capture the effects of a rising expected sex ratio due to improved longevity (and its impact on the sex ratio at birth and mortality patterns), but it may also point to the intensification of gender bias, particularly with regard to sex-selective abortions.<sup>30</sup> An

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<sup>27</sup> Note that these are actual sex ratios and not the share of missing women which would be the difference between actual and expected sex ratios. The latter is very difficult to calculate for India's states over such a long time period.

<sup>28</sup> The states included are grouped into four regions: North consisting of Haryana, Himachal Pradesh, Punjab, Madhya Pradesh, Rajasthan, and Uttar Pradesh, East consisting of Bihar, Orissa, and West Bengal, South consisting of Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu, and West consisting of Gujarat and Maharashtra. In regression 1, the observations for West Bengal and Bihar in 1971 are dropped as there are missing values.

<sup>29</sup> To ensure that the differences in results between the two regressions are not driven largely by omitted variable bias, we also estimate the reduced model for the 1971 to 1991 period. The results were very similar to the 1961-2001 regression shown in column 3.

<sup>30</sup> The time trend may also give some indication of possible underenumeration of females. In particular, the fact that there is little difference in the dummy variable for 1971 and 1981, and between 1991 and 2001 may support

interpretation of the aggregate evidence would thus be to suggest that improving female education and labor force participation in recent years has helped reduce the sex ratio while more effective methods of discrimination (esp. sex-selective abortions) have worsened matters which leads to the worsening time trend.

The reduced regressions for 1961-2001 largely support this picture. Improved female literacy has helped to reduce sex ratios<sup>31</sup> while the worsening time trend has partly off-set this, and may indeed be due to the greater incidence of sex-selective abortions.

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the contention that the 1971 and 1991 censuses were underestimating the number of females and thus the worsening time trend was mitigated by better enumeration in the subsequent census (see Dyson, 2001).

<sup>31</sup> In these reduced regressions, male or female literacy have a similar impact suggesting that it is overall literacy rather than female literacy in particular that is driving the results. But this result is likely to be driven by the omission of female labor force participation as can be seen in the expanded regression in column 1.

Table 5: Determinants of Missing Women in the World and within India

	(1) Worldwide Panel Regression		(2) Panel Regression of Sex Ratios in India's States 1971-1991	(3) 1961-2001
Constant	3.96 (2.35)**	Constant	117.42 (15.27)***	114.83 (53.22)***
Female Labor Force Participation	-0.025 (0.75)	Fem. Labor Force Participation (Main Workers only)	-0.21 (3.46)***	
East Asia*FLFP	2.57*** (3.02)	Female Literacy	-0.17 (1.80)*	-0.17 (4.10)***
Female Literacy	-0.077*** (5.18)	Male Literacy	-0.06 (0.62)	
East Asia	-3.99 (1.06)	Total Fertility Rate	0.20 (0.21)	
South Asia	6.44*** (6.17)	Infant Mortality Rate	-0.03 (1.87)*	
Middle East + North Africa	3.22*** (3.69)	Urbanization Rate	0.26 (3.80)***	
Sub Saharan Africa	0.027* (1.95)	Population Density	0.007 (2.10)**	0.012 (4.54)***
South East Asia	2.99*** (3.57)	South Dummy	-6.81 (5.23)***	-8.24 (7.53)***
Second Observation	-0.045 (0.97)	East Dummy	-5.16 (3.63)***	-7.03 (5.90)***
		West Dummy	-2.67 (1.66)	-0.99 (0.76)
		1961 dummy		-4.57 (2.27)**
		1971 dummy	-3.15 (2.00)*	-3.40 (1.86)*
		1981 dummy	-3.16 (2.79)***	-3.53 (2.14)**
		1991 dummy		-1.06 (0.79)
Adj. R-Squared	0.871		0.872	0.593
N	47		43	75

Note: \*\*\* refers to 99%, \*\* to 95%, and \* to 90% significance levels. Absolute value of t-statistics in brackets. The omitted region is North and the omitted time dummy is 1991 in regressions 1 and 3 and 2001 in regression 2. The states included are grouped into four regions: North consisting of Haryana, Himachal Pradesh, Punjab, Madhya Pradesh, Rajasthan, and Uttar Pradesh, East consisting of Bihar, Orissa, and West Bengal, South consisting of Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu, and West consisting of Gujarat and Maharashtra. In regression 1, the observations for West Bengal and Bihar in 1971 are dropped as there are missing values.

Sources: ILO (2000), Wink (2000), Registrar General (2001).

Based on these findings about the factors influencing the survival patterns of girls, a tentative interpretation of current trends can be attempted. We will split the discussion into the various geographic regions.

#### a) North Africa and West Asia

In North Africa and West Asia, the relative improvement in female survival is not only apparent in the sex ratios but can also be deduced from mortality statistics. In all countries, female life expectancy surpassed male life expectancy in the last two decades and the female advantage is growing (Tabutin, 1991; Makinson, 1994; Obermeyer and Cardenas, 1997). The

most important factors accounting for this relative improvement appear to be improved female education, improved female employment opportunities, and generally rising prosperity in these middle income countries which lessens the need to ration scarce health and nutrition resources to the disadvantage of little girls.

#### b) East Asia

In East Asia, we experience a falling trend of gender bias in mortality Taiwan, and continued high levels of gender bias in China. In South Korea, we see slight worsening, albeit from a very low level. In Taiwan and South Korea, rapidly rising prosperity has reduced the need to ration scarce resources and has sharply improved female education and employment opportunities (World Bank, 2001). At the same time, there continues to be considerable discrimination against female infants which by now appears to have shifted largely to sex-selective abortions. In South Korea, the sex ratio at birth has increased to above 1.1 in the early 1990s which points to a considerable incidence of sex-selective abortions. But due to very low overall fertility rates, the demographic impact of this worrying phenomenon is smaller than elsewhere (Croll, 2000), while the survival advantage of females in older age groups now has a considerably larger demographic impact. Similarly, Taiwan has unusually high sex ratios at birth which appears to be linked to sex-selective abortions (Croll, 2000).

China is the country that has experienced a rising overall sex ratio and the least progress in gender bias in mortality. This is despite considerable improvements in the first few decades of communist rule where the expansion of free public health services and public provision of nutrition greatly reduced the previously existing great discrimination against female children (see Dreze and Sen, 1989; 1995, Klasen, 1993, 1999). The most important reasons for the deterioration in recent years appear to be two-fold. First, the significant changes in the organization of public services in connection with the economic reforms that began in the late 1970s. This involved the dissolution of the communes which had previously provided free health care and food. Now the provision of these goods is largely back into the hands of households which allow discriminatory practices to reemerge (Dreze and Sen, 1995; Banister, 1987; Klasen, 1993, 1999). Second, the one-child policy has sharply increased the incentive of parents to discriminate against female children as they want to ensure that the officially registered child is a boy. This policy has led parents to adopt several strategies to achieve this goal including the abandonment of girl children, illegal adoptions, hiding of girls, the refusal to get the one-child certificate in the case of a first-born girl, and an increasing incidence of sex-selective abortions (e.g. Banister 1987; Banister and Coale, 1994;



Johannsons and Nygren, 1993; Junhong, 2001, Klasen, 1999). The rising sex ratio at birth is testimony to these strategies although it is unclear to what extent the different strategies mentioned are responsible for this rise in the sex ratio to above 1.15 in the 1980s and 1990s (Croll, 2000; Junhong, 2001). But clearly the one child policy is among the most important underlying cause for the poor progress in missing women in China, while improving overall health conditions, incomes, female education and employment opportunities have extended female life spans.

### c) South Asia

In South Asia, we saw dramatic progress in Nepal and Sri Lanka, large progress in Bangladesh and Pakistan, and moderate progress in India. Beginning with Nepal, recent censuses showed dramatic variations in the sex ratio. In 1961 it was alleged to be 0.91, rising to 1.05 in 1981, and falling again to 0.99 in 1991. While some of these oscillations are due to male migration and returns to India, there are serious questions about the validity of these findings. In particular, the drop of the sex ratio in 1991 appears highly implausible. One way to see this is to examine the ratio of 20-24 year old women in 1991 to 10-14 year old girls in 1981. In the impossible case of no mortality in the intervening years one would expect as many 10-14 year olds in 1991 as 0-4 year olds in 1981, i.e. the ratio would be 1. In fact, it is 1.09; and the ratio of 25-29 year old women in 1991 to 15-19 year old women in 1981 it is an even more implausible 1.15 (Central Bureau of Statistics, 1995). This points either to improved enumeration of females in 1991, or under-enumeration of males. Existing analyses of mortality trends continue to point to higher mortality of girls between 1 and 4 years, although the extent of excess female mortality is smaller than elsewhere in South Asia (Pradhan et al. 1997). Given the paucity of data, it is difficult to tell at present to what extent there indeed has been an improvement or not.

In Pakistan, there has been a considerable reduction in the sex ratio in 1998 which followed an earlier reduction in the 1981 census. But these improvements came from extremely high levels. In 1972, the population sex ratio stood at 1.14, and dropped to a very high 1.10 in 1981 (Government of Pakistan, 1995). A part of the improvements is likely to be related to improved enumeration of females, as can be seen when one compares the age structure of the two censuses. At the same time, there appears to have been a real improvement as well, mostly related to improved female education and employment opportunities, and rising urbanization. But clearly, female disadvantage prevails as can also

be seen in considerably higher post-neonatal and child mortality rates of female children (Wink, 2000).

In Bangladesh, there have been steady reductions in the sex ratio since 1974. While some of this might also be related to improved enumeration of females in later censuses, also here there appear to have been real improvements which can also be seen in mortality statistics (Wink, 2000). Rapidly rising female education (from a very low level) and improving employment opportunities (aided by the greater availability of microcredit to women)<sup>32</sup> are likely causes for these improvements from a low base.

Sri Lanka is a country that has experienced a dramatic turnaround in gender bias in mortality. The sex ratio declined from 1.15 in 1951 more or less continuously to an estimated 1.00 in 1991. Data on mortality differentials bear out these changes (Nadarajah, 1983; Langford and Storey, 1993). Critical to the success in Sri Lanka were the free provision of food and health care which obviated the need for households to ration these vital resources differentially and ensured adequate access for girls. Investments in female education and employment added to this positive trend (see Dreze and Sen, 1995; Klasen, 1999).

Lastly, we turn to India. Here we see a slight reduction in the sex ratio in the 2001 census after a deterioration in 1991. In fact, the 2001 results are similar to the 1981 results and there are reasons to believe that some of the oscillations are also due to better female enumeration (Dyson, 2001). While some authors had predicted an improvement in the sex ratio (Dreze and Sen, 1995; Wink, 2000), others have predicted a worsening of the situation (Das Gupta and Mari Bhat 1997, Mayer, 2000). In fact, several opposing trends seem to operate here. On the one hand, there is evidence of clear improvements in female survival, particularly in older ages. The relative mortality of females above age 30 has steadily improved over the past decades (Wink, 2000; Dreze and Sen, 1995). Conversely, the sex ratio among 0-4 year olds has steadily increased pointing to increasing disadvantage of young girls or to increasing sex-selective abortions. The latest census results point particularly to the rise of the latter phenomenon which is consistent with the rise in the sex ratio at birth (Registrar General, 2001; Dreze and Murthi, 2001).

The regression results of Table 4 support this opposing trends. On the one hand, rising female employment opportunities and particularly rising female literacy has helped reduce gender bias in mortality, while the negative time trend would be consistent with greater access to means of discrimination, particularly through the increased recourse to sex-selective abortions.

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<sup>32</sup> See Pitt and Khandker (1998) and literature cited therein for evidence that would support this suggestion.

## 6. Conclusion

While the number of missing women has risen in absolute numbers over the past 10 years, there appears to be a relative improvement in the share of missing women suggesting that the phenomenon has stabilized at a high level. Thus the projections made by the UN Population Division shown in Figure 1 have been highly prescient when they predicted a peak in the sex ratio in female-deficit countries around 1990, although the predicted decline has been smaller than they anticipated.<sup>33</sup> Regional analyses point to definite improvement in North Africa and West Asia, some improvements in South Asia which, however, appear overstated and are partly related to better enumeration of females, and little improvement in China related largely to its strict family planning policies. Improvements in Bangladesh and Pakistan ensure that India now has the largest share of missing females in the world, and only a slightly lower absolute number of missing women than China.

In these regional trends, the predictions by the UN were somewhat less accurate. While they correctly predicted declines in the sex ratios in North Africa, West Asia, and Pakistan, they predicted larger declines in the sex ratio in India and China than have actually materialized, probably for the reasons discussed above.

Improving female education and employment continue to be important avenues for lowering the sex ratio. This is an important area of state intervention. In addition, state policies can intervene by directly delivering adequate nutrition and health care for girls which has shown remarkable success in Sri Lanka, Kerala, and pre-transition China. Lastly, the increasing ability to discriminate against girls, particularly in the advent of sex-selective abortions, necessitates increasing intervention to reduce the underlying causes of gender bias in mortality. Despite slight improvements in recent years, it does not appear that the problem will disappear rapidly on its own, as suggested by the estimates from the UN in Figure 1. Instead, greater efforts are needed to combat this most egregious form of gender discrimination in coming years.

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<sup>33</sup> This prediction was not only made in the most recent (1998) revision, but could also be seen in earlier estimates.

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