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Consequences of Son Preference in a Low-Fertility Society: Imbalance of the Sex Ratio at Birth in Korea

Chai Bin Park
Nam-Hoon Cho

A central concern of demographers and population planners has been the impact on family size of parental preferences for the sex of their children, especially in patriarchal developing societies in Asia. If parents continued to bear children until they reached their desired sex combination of children or their desired number of sons, sex preference would be a major barrier to fertility reduction. Sheps (1963) has shown theoretically that the expected average family size would be 3.88 children if couples continued childbearing until two sons were born. In fact, abundant empirical evidence shows a close relationship between sex preference and fertility.[1]

In China and Korea (these designations refer to Mainland China and South Korea, respectively, throughout the article), fertility has recently declined precipitously to the replacement level or even below, in spite of their populations' strong adherence to son preference. In these countries, however, probably to accommodate both sex preference and a small-family norm, a new demographic phenomenon of a distorted sex ratio (number of males per 100 females) at birth is emerging at three levels: in the population at large, between families, and within families. At the population level, a rising trend has been recorded in the sex ratio. At the between-family level, large families have low sex ratios and small families high sex ratios. At the within-family level, a rapidly rising sex ratio is reported with rising birth order, and the sex ratio of last-born children is extremely high.

In this article we present empirical evidence of these changes in the sex ratio at birth, focusing on Korea. Then we discuss possible demographic, social, health, and other implications of the changes. The principal means of altering the sex ratio at birth, also known as the secondary sex ratio, are sex-selective abortion and differential contraceptive use depending on the sex distribution of existing children. We do not consider female infanticide and failure to report female births, both prevalent in China according to some authors, to be factors in Korea.[2] While sex-selective abortion alters the secondary sex ratio at all three levels, differential contraceptive use can alter sex ratios at the between-family level and can change the sex ratio of last-born children within families of any given size (Park 1983). Fearing a wide practice of sex-selective abortion in the country, the Korean government is now enforcing strong measures to curb the use of technologies for the sex determination of fetuses.

Recent changes in sex ratios at birth

Sex ratio of the aggregate population

Table 1 presents the recorded sex ratios of children by single year of age through age four years for China, Taiwan, Korea, and Hong Kong, the East Asian countries that have recently attained low levels of fertility. Hong Kong's sex ratio may have been influenced by differential migration by sex to and from China, especially at later ages; but in other countries migration should have little, if any, influence on the sex ratio of children. Usually male mortality at these ages slightly exceeds female mortality. In a strict sense the sex ratio at birth should be slightly higher than the ratio recorded at ages 0–4, and the discrepancy between the two sexes should decrease with age. Nevertheless, by and large the recorded sex ratios of children under age five may be regarded as reflecting the general level of a population's sex ratio at birth.

It appears that in all four areas during the 1980s—more specifically after about 1985—the sex ratio at birth began to rise. We have no evidence before that time of anomalous sex ratios, each area conforming to the world average of around 106.[3] A marked increase in the sex ratio was noted in China for children below age four in 1990, that is, for the birth cohorts of 1986 and after; the increase in China's reported sex ratio has attracted considerable attention.[4] In Taiwan the sex ratio for the population under age one has risen since 1987. In Korea the sex ratio for all ages under five jumped in 1990 to 109 or higher; in addition, some rise is noted for age zero in 1985. In Hong Kong it appears that the sex ratio of children under three years of age rose in 1991. Thus the initial year of increase in the sex ratio at birth appears to be around 1985 in Korea, 1986 in China, and 1987 in Taiwan. The figures for Hong Kong show erratic fluctuations, probably due mainly to small sample size, but the level of recent sex ratios is definitely higher than in earlier decades. In contrast, census reports for Japan, a country with no known sex preference, reveal no such increase in the sex ratio of young children.[5]

TABLE 1 Recorded sex ratios (number of males per 100 females) of children under five years of age: China, Taiwan, Korea, and Hong Kong, selected years

Location and year	Age (years) 0	1	2	3	4
China					
1953	104.9	105.6	106.6	108.6	109.4
1964	103.8	105.3	106.4	106.9	108.7
1982	107.6	107.8	107.4	106.7	106.2
1990	111.7	111.7	110.2	109.3	108.4
Taiwan					
1981	107.3	106.5	107.0	107.0	106.0
1982	107.3	106.6	106.3	106.4	106.8
1983	106.7	106.8	106.4	106.0	106.4
1984	107.8	106.1	106.4	106.6	105.9
1985	106.6	107.0	106.1	106.5	106.5
1986	106.9	106.7	106.7	106.1	106.5
1987	108.5	106.7	106.4	106.8	105.9
1988	108.7	107.9	106.7	106.6	106.7
1989	108.2	108.0	107.9	107.1	106.4
1990	109.1	107.5	107.4	107.5	106.6
Korea					
1930	101.5	102.3	102.0	102.9	104.2
1935	103.6	102.5	102.2	103.9	103.2
1940	103.6	101.6	101.8	102.7	103.5
1944	98.6	103.5	102.6	102.1	103.1
1955	105.7	106.3	106.0	108.1	107.5
1960	105.8	105.5	103.4	106.6	106.6
1966	107.5	106.9	106.5	108.0	107.3
1970	106.5	106.9	105.8	106.7	108.0
1975	108.1	108.2	106.3	107.5	107.3
1980	108.3	106.8	106.6	107.5	107.1
1985	108.6	107.4	105.6	107.4	107.1
1990	112.5	111.6	111.2	109.3	111.4
Hong Kong					
1961	103.3	107.0	106.5	106.1	106.9
1971	106.2	105.3	106.0	105.5	104.8
1976	107.0	108.5	106.5	108.7	110.2
1981	110.7	109.5	108.6	108.2	109.2
1986	108.4	114.2	106.9	105.3	110.0
1991	109.7	109.0	110.1	108.4	107.3

SOURCES: China: China, People's Republic of (1986); China, People's Republic of, State Statistical Bureau (1985, 1993). Taiwan: China, Republic of, Ministry of Interior (1982–91). Korea: Korea, Government General of (1935, 1939, 1944, 1945); Korea, Republic of, Bureau of Statistics (1959); Korea, Republic of, Bureau of Research and Statistics (1963, 1969, 1973); Korea, Republic of, National Bureau of Statistics (1977, 1982, 1987); Korea, Republic of, National Statistical Office (1992). Hong Kong: Hong Kong Census Commissioner (1962); Hong Kong Department of Census and Statistics (1972, 1978, 1982, 1987, 1992).

Other independent sources of information also strongly suggest a sudden increase in the sex ratio at birth in Korea and Taiwan. A series of school-enrollment statistics for Korea reveals a discontinuous and consistent rise in the sex ratio of pupils born after April 1984 (see Table 2). As we show later, Korean birth registration data indicate a sudden jump in the sex ratio starting in 1985. Taiwan's vital statistics data also show that for the period 1960–86 the annual sex ratio of registered births was around 106, but it increased to 108.3 in 1987 and jumped to 110.2 in 1990 (Chang 1993).

This sudden rise in the recorded sex ratios of young children is a novel trend in the long series of demographic data for these countries. Except in the case of Hong Kong, the population size is sufficiently large to make the role of random variation negligible. The sex ratios of survivors of a given birth cohort followed over time present consistent levels. In Taiwan the survivors of children under one year of age in 1987 and in subsequent birth cohorts show similarly high sex ratios at later ages. As shown in Table 3, in Korea the survivors of the age groups having normal sex ratios in 1985 generally maintained similar levels in 1990, while the high sex ratio of the zero-year-olds in 1985 was retained by the children five years old in 1990.

An examination of Korean sex ratios by geographic area over time further illuminates the trend (see Table 4). In 1980 the sex ratio of young children was within a normal range throughout Korea, but in 1985 some cities like Taegu and Pusan began to present high ratios, and in 1990 the ratio became uniformly high, irrespective of community size. In general the sex ratio rose earlier in large cities than in towns or rural areas. Table 4 suggests that the year the sex ratio at birth reached a consistent level of 110 or more is 1985 for cities, 1986 for towns, and 1988 for rural areas. The level of the sex ratio at birth in Taiwan is also related to the size of cities, with the birth-order-standardized sex ratio for Taipei being 112 followed by 110 for Kaohsiung City and 109 for provincial cities (Chang 1993). Among the six mega-cities in Korea, Taegu records extremely high sex ratios at 0–4 years, ranging from 122 to 130 in 1990. Even the rural area

TABLE 2 Sex ratios of school children under 12 years of age: Korea, 1991–93

Age (years)[a]	1991	1992	1993
6 or less	108.4	109.1	108.8
7	106.8	107.9	109.2
8	106.3	106.8	108.3
9	105.6	106.4	106.7
10	106.0	105.7	106.5
11	105.9	106.0	105.8

[a]As of 1 April. Adapted from *Statistical Yearbook of Education*, 1991, 1992, and 1993: Table 3-10. Seoul: Ministry of Education.

TABLE 3 Sex ratios of children under five years of age in 1985 and sex ratios among their survivors in 1990: Korea

1985		1990	
Age	Sex ratio	Age	Sex ratio
0	108.6	5	108.8
1	107.4	6	108.2
2	105.6	7	107.0
3	107.4	8	106.3
4	107.1	9	106.5

Source: Census reports.

TABLE 4 Sex ratios of children under five years of age by administrative area: Korea

Administrative area		Age (years) 0	1	2	3	4
Cities	1980	108.0	106.8	107.3	108.2	107.9
	1985	110.9	108.3	108.4	108.1	107.9
	1990	112.3	111.6	111.5	109.5	111.9
Towns	1980	107.8	106.2	105.8	106.5	107.0
	1985	108.6	107.4	105.6	107.4	107.1
	1990	111.1	112.4	109.2	109.5	110.8
Rural	1980	109.4	107.2	105.7	106.7	105.8
	1985	109.7	107.5	106.0	105.3	104.8
	1990	115.3	111.4	110.3	107.9	108.8
Mega-cities[a]						
Seoul	1980	107.9	107.0	108.7	108.1	107.8
	1985	109.2	108.6	109.4	108.8	108.3
	1990	109.9	108.8	110.4	109.8	111.8
Pusan	1980	109.6	107.1	105.5	108.9	107.7
	1985	113.4	107.8	108.4	107.8	108.3
	1990	114.1	112.7	110.5	108.4	112.6
Taegu	1980[b]	109.3	107.8	107.0	108.6	109.3
	1985	123.2	113.0	109.4	107.7	111.6
	1990	124.0	125.8	130.2	121.7	124.7
Inchun	1985	109.4	108.4	105.6	107.4	107.3
	1990	108.4	107.5	106.5	106.7	107.8
Kwangju	1990	110.8	108.4	105.7	107.8	107.4
Taejun	1990	118.4	119.8	116.3	111.2	112.0

[a]Cities administratively under the direct control of the national government.
[b]For all cities of Kyungsangpuk Province, which includes Taegu City. In 1980 Taegu was not controlled by the national government but it contained more than 70 percent of the province's urban population.
SOURCE: Census reports.

surrounding this city has very high ratios. The area, however, did not present abnormally high sex ratios in 1980. This area, which produced three generals who have ruled the country for the past 30 years, is considered to be very conservative, having a strong parochial tie popularly known as the TK (Taegu–Kyungsangpuk Province) sentiment. Son preference may be particularly strong there.

Although in China selective abortion, underreporting of female births (Hull 1990; Zeng et al. 1993), and female infanticide (Aird 1990; Johansson and Nygren 1991) are claimed to be major causes of the rising sex ratio at birth, in Taiwan and Korea we consider selective abortion the sole cause of rising sex ratios. We have no reason to suspect that female births are being hidden in these countries, because neither coercive regulation of fertility nor an abrupt change in the family planning program has occurred there. Ill treatment of baby girls, as compared with baby boys, is possible; but overt sex-selective infanticide is beyond imagination. The lag in the rise of the sex ratio in rural areas may be largely explained by a lesser availability there than in urban areas of medical facilities to determine fetal sex. Son preference in rural areas is expected to be stronger than in urban areas.

Family-size-specific sex ratios

Table 5 presents sex ratios of children at birth, by family size, for China and Korea. In recent years the sex ratio has dropped as family size has increased. The 1985 China In-Depth Fertility Survey shows that while the sex ratio of siblings consistently declined with family size in the highly developed province of Hebei, it dropped abruptly from 130 to 108, if family size reached four children, in the less developed province of Shaanxi (Wen 1993). The Korean data demonstrate a sex-ratio transition by family size. When contraceptive use was practically nonexistent (1929–40), the sex ratio did not vary with family size, except for five-child families for which the sample size was relatively small. But in the early years of the country's population program (1966–74) a sudden decline in the sex ratio occurred between the family sizes of three and four children in Seoul. In 1991, when fertility fell below replacement level, a decline in the sex ratio occurred between the family sizes of two and three in the full sample, and a systematic and precipitous decline took place with family size among women aged 35–44 with completed fertility.

When fertility is in a transitional stage in societies with strong son preference, there appears to be a threshold of family size below which the sex ratio is very high and above which it drops abruptly. Once the fertility transition is completed, however, the threshold disappears and a clear negative association emerges between the sex ratio and family size. Note in the last row of Table 5 the remarkable contrast between one-child families,

TABLE 5 Sex ratio at birth by family size: China, 1985, and Korea, 1929–91

Country	Family size 1	2	3	4	5
China[a]					
Hebei Province	144.0	126.4	114.8	103.0	88.0
Shaanxi Province	129.1	126.9	126.6	107.6	99.3
Korea[b]					
1929–40	95.6	99.0	96.6	99.0	109.2
1966 (Seoul)	120.5	122.0	113.2	102.7	105.9
1974	114.4	126.1	129.9	106.6	102.3
1991 (full sample)	135.7	135.4	102.7	86.6	58.6
1991 (completed fertility)	206.9	159.8	103.2	78.4	49.0[c]

NOTES and SOURCES
[a]1985 In-Depth Fertility Survey (Wen 1993: Table 1).
[b]1929–40: Keijo (Seoul) Imperial University Hospital Clinic data (adapted from Matsuyama 1944); 1966: Seoul Fertility Survey (adapted from Yoon 1967); 1974: World Fertility Survey (adapted from Park 1983); 1991: Fertility and Family Health Survey.
[c]For the first four children only.

which have a sex ratio exceeding 200, and five-child families, which have a ratio below 50. The declining sex ratio with family size has been noted for 1974 (Park 1983), when sex-selective abortion was not known to exist. Differential contraceptive use depending on sex composition of existing children alone can cause this kind of imbalance, if couples who happen to bear daughters early in their married lives tend to continue childbearing, while those who happen to bear sons early are motivated to stop. Practice of selective abortion must have widened the difference in the sex ratio by family size.

Birth-order-specific sex ratios

The sex ratio at birth has been positively associated in recent years with birth order in Korea, China, and Taiwan, as shown in Table 6.[6] In China a sudden increase in the ratio can be seen between birth orders two and three during 1981–83; but since 1984 the increase has occurred between birth orders one and two, the jump frequently exceeding 10 points. The sex ratio for birth order one maintains the normal level throughout. In Taiwan a discontinuous rise was recorded between birth orders two and three in 1990. This increasing ratio with birth order is easily explained: if family size must be limited in a society with strong son preference, female births after a certain number of children must be suppressed through methods like selective abortion and selective infanticide, so that the desired number of sons may be attained within the family-size norm.

TABLE 6 Sex ratios at birth by birth order: China, Korea, and Taiwan

Year	Total	Birth order 1	2	3	4	5+
China						
1981[a]	107.8	105.3	107.2	113.1	115.5	109.5
1982[b]	107.2	106.5	105.0	109.4	113.8	110.3
1983[b]	107.7	107.5	107.2	108.2	105.4	113.3
1984[b]	108.3	102.1	113.6	112.6	116.8	128.3
1985[b]	111.2	106.1	116.1	114.3	126.5	116.6
1985[c]						
Hebei	112.6	116.3	103.5	114.3	127.6	
Shaanxi	115.1	107.2	116.7	118.3	132.9	
1986[b]	112.1	105.2	116.8	123.2	125.0	124.3
1986[a]	113.6	107.9	116.6	119.2	130.7	126.0
1987[b]	110.8	106.7	112.6	118.9	118.1	125.6
1989[d]	113.8	104.9	120.4	124.6	132.7	129.7
Korea						
Vital statistics data (current births)[e]						
1980	103.9	105.7	104.2	102.7	99.1	
1982	106.9	105.5	106.1	109.3	114.2	
1983	107.7	106.0	106.3	112.5	122.1	
1984	108.7	106.4	107.5	118.5	131.7	
1985	110.0	106.3	108.2	131.7	157.2	
1986	111.9	107.4	111.4	139.4	154.6	
1987	109.0	104.8	109.2	135.7	147.4	
1988	113.5	107.4	113.4	166.9	192.9	
1989*	112.1	104.3	112.6	185.0	208.6	
1990*	116.9	108.7	117.3	193.2	228.1	
1991*	112.9	106.1	112.8	184.7	212.3	
1992*	114.0	106.4	112.8	195.7	228.6	
Survey data (retrospective births)						
1974[f]	106.5	107.3	107.8	110.7	105.0	103.8
1991[g]	107.9	110.1	102.7	113.4	113.3	101.2
1991[h]	110.8	117.9	98.5	115.6	126.7	
Taiwan						
1990[i]	112	108	110	134	159	

NOTES and SOURCES:
[a]China's One-per-1,000 Survey (Coale 1992).
[b]China's Two-per-1,000 Survey (Coale 1992).
[c]In-Depth Fertility Survey (Wen 1993).
[d]1990 Census of China (Coale 1992).
[e]National Statistical Office of Korea; * = preliminary figures. Data for 1981 are not available to authors.
[f]World Fertility Survey (adapted from Park 1983).
[g]1991 Fertility and Family Health Survey, full sample.
[h]1991 Fertility and Family Health Survey, births to women 35–44 years of age (completed fertility).
[i]Vital statistics data (Chang 1993).

The time trend of the birth-order-specific sex ratio is also well demonstrated by the Korean registration data.[7] Vital statistics record no specific association prior to 1981, but during 1982–85 an abrupt rise in the sex ratio was observed from birth order three, and after 1985 from birth order two. In recent years a systematic rise in the sex ratio appears to be taking place with birth order. Data for 1989 and thereafter show that the sex ratio for birth order four and above exceeds 200. Retrospective data from the 1974 World Fertility Survey, which included all past births of the respondents, suggested no particular relationship between sex ratio and birth order, consistent with the vital statistics data.

The 1991 survey data presented a very different picture, however. The sex ratio of second-order births dropped sharply, but all other birth orders including the first had very high sex ratios. The trend was the same whether for the entire sample or for completed fertility, the latter case showing more exaggerated fluctuations. Thus, the survey data do not agree with the registration data. Although the two data sources are different—vital registration data dealing with current births and survey data dealing with lifetime or past cumulative births—this is a puzzling situation. Interestingly, Wen (1993) also finds, using 1985 retrospective data, a surprisingly high sex ratio for the first-born and an unusually low sex ratio for the second-born in the developed province of Hebei but not in underdeveloped Shaanxi in China.

The high sex ratio of first-born children makes us suspect that Korean women now apply sex-choice technology to ensure the outcome of first-order births. Koreans have a strong preference for a son as the first child, especially if they intend to raise only one or two children. Even in Western countries couples seem to want male and female children born in a certain order. An analysis of the 1970 US National Fertility Study led Westoff and Rindfuss (1974) to declare that "the most lasting implication of the introduction of sex-control technologies would appear to be a significant increase in the probability of the firstborn being a male, and the second child being a female" (p. 636). Fidell, Hoffman, and Keith-Spegel (1979) report that in a large sample of American university students 85 percent wanted a boy to be born first and 73 percent a girl to be born second. Similar findings are reported elsewhere (Markle and Nam 1971; Markle and Wait 1976). This American preference for "first a son and second a daughter" may also be prevalent in Korea.

As shown in Table 7, among Korean couples with completed fertility the sex ratio of second-born children following a male birth was 94.0, while that following a female birth was 103.9; the low sex ratio of 94 is significantly different from the "normal" level of 107, implying that, if a first-born child was a male, women chose to have a female for a second-born child. Table 7 further shows that in 1974 none of the 15 sex ratios classified

TABLE 7 Sex ratios at birth by birth order following specified sex sequence of previous births: Korea, 1974 and 1991

Birth order	Preceding sex sequence	1974		1991 Full sample		1991 Completed fertility	
		Number	Sex ratio	Number	Sex ratio	Number	Sex ratio
1		4978	106.5	6857	110.1	2770	117.9*
2	M	2196	104.7	2802	103.2	1350	94.0*
	F	2068	111.2	2681	102.2	1199	103.9
3	MM	869	105.4	466	105.3	237	107.9
	MF	875	113.4	567	98.9	354	110.7
	FM	868	110.7	482	104.2	264	100.0
	FF	821	111.2	839	136.3*	456	135.0*
4	MMM	306	109.6	73	135.5	28	250.0
	MMF	302	100.0	74	76.2	30	76.5
	MFM	301	96.7	74	146.7	36	140.0
	MFF	318	116.3	127	115.3	59	118.5
	FMM	310	118.3	77	120.0	37	117.6
	FMF	313	100.6	117	88.7	60	100.0
	FFM	337	100.6	129	101.6	62	106.7
	FFF	318	100.0	242	130.5	130	154.9*

M=male; F=female.
* Difference from a ratio of 107 is statistically significant ($p<0.05$).
SOURCES: For 1974, Korean World Fertility Survey; for 1991, Fertility and Family Health Survey.

by sex sequence of earlier births was significantly different from the level of 107. On the other hand, in the entire sample of 1991 data the sex ratio of third-born children following the sex sequence female–female was significantly different from 107. Among women with completed fertility, for whom the sample size was much smaller, significantly higher-than-normal sex ratios were noted with the first-order birth, the third-order birth following two female births, and the fourth-order birth following three female births. Sex-selective abortion appears especially prevalent among families having only daughters.

Sex-ratio distribution by birth order and family size suggests an intricate consequence of the combined preference for sons and for small families. Sex ratios by birth order and family size present similar trends for Korea and China and for either incomplete or completed fertility: that is, a clear negative correlation between sex ratios and family size in every birth order, and extremely high sex ratios for last-born children, regardless of family size (see Table 8). With these common features, why is the Korean sex-ratio distribution by birth order so different between 1974 and 1991, as seen in Table 6? It is a joint consequence of changes in the family-size distribution and differential selective abortion by birth order and sex sequence. First, we note a growing gap between 1974 and 1991 in the sex ratio with family size in a given birth order. For instance, in 1974 the sex ratio of a

TABLE 8 Sex ratios at birth by birth order and family size: Korea, 1974 and 1991, and China, 1985

Family size	Number	Sex ratio by birth order 1	2	3	4	5
Korea						
1974[a]						
1	714	114.4				
2	831	119.3	133.4			
3	928	125.8	119.9	145.5		
4	842	102.4	99.0	98.1	130.0	
5	647	97.3	102.8	97.3	94.9	121.6
6+	1016	90.3	91.0	104.0	93.9	93.9
1991 (Full sample)[b]						
1	1374	135.7				
2	3129	130.1	140.9			
3	1441	90.6	72.8	165.4		
4	585	65.7	70.1	76.7	158.8	
5+	328	54.7	43.9	43.2	62.4	101.2
1991 (Births to women aged 35–44)[b]						
1	221	206.9				
2	1238	158.4	161.2			
3	869	101.6	66.2	164.1		
4	309	54.5	60.9	67.0	166.4	
5+	133	49.4	40.0	41.5	68.4	—
China						
1985 (Hebei Province)[c]						
1		144.0				
2		120.0	133.3			
3		111.9	100.4	134.8		
4		85.9	85.9	107.8	143.4	
5+		96.4	72.4	81.6	84.6	100.7
1985 (Shaanxi Province)[c]						
1		129.1				
2		114.3	141.2			
3		120.8	105.9	159.8		
4		95.1	109.8	101.1	127.7	
5+		95.4	95.7	95.4	99.9	105.5

SOURCES:
[a]1974 World Fertility Survey (adapted from Park 1983).
[b]1991 Fertility and Family Health Survey.
[c]In-Depth Fertility Survey (Wen 1993); source does not give number of births.

TABLE 9 Sex ratios of last-born children and earlier children: Korea, 1974 and 1991, and China, 1985

Country/year	Family size	Sex ratio: Last-born	Sex ratio: All others
Korea			
1974	2	133.4	119.3
	3	145.5	122.8
	4	130.0	99.8
	5	121.6	98.0
1991 (Full sample)	2	140.9	130.1
	3	165.4	81.2
	4	158.8	70.7
1991 (Births to women aged 35–44)			
	2	161.2	158.4
	3	164.1	82.2
	4	166.4	60.6
China			
1985 (Hebei Province)	2	133.3	120.0
	3	134.8	106.0
	4	143.4	92.7
	5+	113.2	83.5
1985 (Shaanxi Province)			
	2	141.2	114.3
	3	159.8	113.1
	4	127.7	101.8
	5+	115.5	96.3

SOURCES: Same as in Table 6

first-order birth ranged from 126 to 90 depending on the eventual size of the family, while in 1991 the sex ratio of the same order birth ranged from over 200 to 50 among women who had completed their fertility. Second, the family size distribution drastically changed between the two dates. In 1974 fully 33 percent of women had five or more children, whereas in 1991 fewer than 5 percent, either in the entire sample or among women with completed fertility, had five or more births. In 1974, 31 percent of women had one or two births; in 1991, 66 percent of the entire sample and 53 percent of women with completed fertility had only one or two births.

In 1974 the overall sex ratio of a specified birth order was influenced largely by the sex ratios of large families; whereas in 1991 the average sex ratio of low birth orders was influenced essentially by those of small families, and the average sex ratio of high birth orders was determined by those of large families, as high-order births are possible only among large families.[8] The peculiar distribution of the 1991 birth-order-specific sex ratio is presumably a product of a widespread preference for small families and the selective application of sex-choice technology by birth order and the previous sex sequence of children.

The contrasts in sex ratios between last-born and earlier-born children are shown in Table 9. Although differences are obvious between the two ratios within a given family size, they are relatively small in two-child families and enormous in large families. For completed fertility in Korea in 1991, the difference between the two sex ratios is twofold among three-child families and nearly threefold among four-child families. Evidently couples who have girls in the early stage of family building keep bearing children or abort female fetuses until a son arrives and then stop.

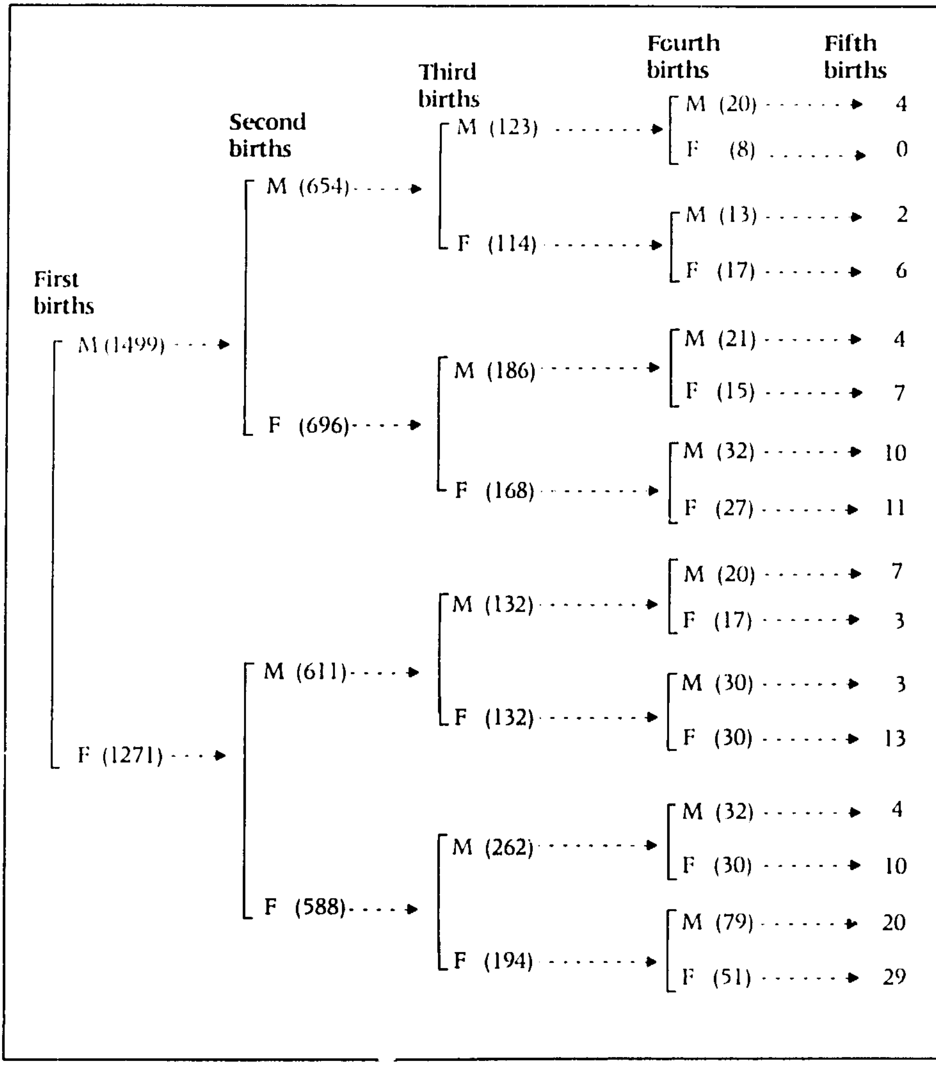
Implications of sex-ratio imbalances

The implications of sex-ratio imbalances in a population and in the family are multifarious. Mainly because of data availability and our familiarity with the country, the discussion focuses on the Korean situation, which is apparently caused by selective abortion and differential contraceptive use. Although Hull (1990) has provided an excellent discussion of the implications of rising aggregate sex ratios in China, he does not address the implications of imbalanced sex ratios at the family level.

Demographic implications

The rising aggregate sex ratio at birth in Korea raises two related demographic questions. First, did family size decrease because of artificial control of children's sex? Second, how many female births have been averted by selective abortion? To answer the first question, we have constructed a family-growth model patterned after the observed sex sequence of children born to women aged 35–44 in the 1991 survey. As shown in Figure 1, the model assumes that all married women bear at least one child, the sex ratio of first-order births being 117.9 as observed (1499 male births against 1271 female births). On the basis of the survey results we assume that 90.1 percent of women (1350/1499) whose first child is a boy will bear another child, resulting in a sex ratio of 94.0 (654/696), and that 94.3 percent of women (1199/1271) whose first birth is a girl will proceed to parity two, with a sex ratio of 103.9 (611/588). Thus, by using the last two columns of Table 7 we model the growth of the family to birth order five, conditional on the gender of the preceding child. We assume, for simplicity, that the maximum number of births per woman is five.[9] We assume further that this family-growth tree reflects the presence of sex preferences and sex-choice technology. We call the family growth model under this assumption Model II.

FIGURE 1 Observed family-growth tree for women 35–44 years of age: 1991 Korean Fertility and Family Health Survey (Model II)



If sex preference is operating without sex selection, the observed sex-specific parity-progression ratio would remain unchanged, as in Model II; but at each stage of family building the sex ratio at birth is held constant, say, at 107. This is our Model I family-growth tree. We construct another family-growth model under the absence of sex preference (Model III). In this case the sex ratio at each parity is held constant, as in Model I, but the

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lowest parity-progression ratio observed in Model I at each stage will prevail regardless of sex composition (Arnold 1985; Park 1986).

Once such a family-growth model is constructed, the proportion of women at each parity is calculated and the expected number of births per lifetime per woman is easily derived. Table 10 summarizes the results of these models. The reduction in the average family size attributable to the use of sex-choice technology is negligible from the case of sex preference alone, average size declining from 2.61 to 2.60 children. In contrast, the difference in the expected average size is considerable between the sex-preference and no-preference models. One cautionary remark is called for here. In these models we are interested in presenting the relative level of family size and parity distribution under each model rather than in presenting absolute levels. The absolute level may be somewhat lower, as we have assumed that every woman is fecund. On the other hand, since the models assume the maximum number of children per woman to be five, the results are likely to be underestimates. Moreover, the model is based on the fertility experience of women aged 35–44 in 1991. As sex-selective abortion has presumably become popular since about 1985, it is likely that the cohort is less exposed to selective abortion than are the younger generations. The actual impact of selective abortion on fertility may therefore be larger than presented here. Whatever the real situation may be, family size under the presence of selective abortion must lie somewhere between Model I and Model III. We therefore consider the impact of sex-choice technology on fertility to be moderate, at least for the time being.

Next we turn to the second question: How many female births have been averted through selective abortion? The estimation of such numbers depends on the difference between the "normal" and the observed levels of the sex ratio, assuming, for simplicity, no differential mortality by sex (Hull 1990). Applying three levels of "normal" sex ratios to the 1990 census data, we have estimated the annual number of female births averted during 1986–90 (see Table 11). According to the medium-level estimation (sex ratio of 106), the annual number of female fetuses aborted appears to

TABLE 10 Percent distribution of completed families by size, under three family-building models

Model	Family size 1	2	3	4	5	Average family size
I	7.9	44.7	30.8	11.4	5.2	2.61
II	8.0	44.7	31.4	11.2	4.8	2.60
III	9.9	57.4	26.2	5.8	0.6	2.30

Model I: Family-building process with sex preference.
Model II: Family-building process with sex preference and sex-selective abortion (observed distribution).
Model III: Family-building process with no sex preference.

range between 10,000 and 18,000, amounting to nearly 80,000 during the five years 1986–90. These "missing" girls represent about 5 percent of actual female births.

TABLE 11 Estimated number of female births averted, assuming three levels of the normal sex ratio at birth: Korea, 1986–90

Normal sex ratio	1986	1987	1988	1989	1990	Total
105	19,300	12,800	18,400	19,800	21,300	91,600
106	16,100	9,800	15,300	16,700	18,300	76,200
107	13,000	6,800	12,200	13,600	15,400	61,000

Social implications

The most popularly feared social implication of the rising sex ratio at birth is the possible marriage squeeze in the future. Sensational reports in newspapers and magazines warn of the future shortage of brides,[10] and the public is alarmed about this situation. Young rural men are already having difficulty finding wives because of the grossly unbalanced sex ratios following the exodus of young women to urban areas in search of employment and better lifestyles.

Mate selection is a complicated issue, but the 1991 Korean Fertility and Family Health Survey reveals that among those married in 1990–91 there was on average a four-year age difference between husbands and wives. Assuming that age is the only criterion in selecting a mate and the current average age difference is maintained, the future imbalance in matching can be easily projected. If no mortality is assumed, males aged 20–24 in 1990 should face little difficulty in finding mates, but 27 out of every 100 males aged 5–9, if their mates were then 1–5 years old, would find no partners to marry (see Table 12). Actually, the situation would be worse, as males aged 15–19 in 1990 already outnumbered their age-wise partners by 18 percent. If the "surplus" males must find their mates from the next younger pool of females and males aged 10–14 in turn have to do the same, the marriage market for males aged 5–9 in 1990 will be extremely tight; nearly 50 percent of them will not be able to find mates in the appropriate age range.

This would-be marriage squeeze has been caused more by rapidly declining fertility than by sex selection. As the absolute number of births becomes smaller year by year and men look for younger women to marry, the number of excess males in the marriage market grows. Sex-selective abortion was uncommon when girls aged 11–15 in 1990 were conceived,

TABLE 12 Comparison of the number of males in five-year age groups with the number of females four years younger: Korea, 1990 census

Males		Females		
Age	Number	Age	Number	M/F (x100)
25–29	2,160,912	21–25	2,073,159	104.2
20–24	2,294,290	16–20	2,220,129	103.3
15–19	2,267,129	11–15	1,926,386	117.7
10–14	2,054,494	6–10	1,959,426	104.9
5–9	1,999,901	1–5	1,573,958	127.1
			(1,635,000)	(122.3)

NOTE: Number in parentheses for females aged 1–5 years includes "missing" girls.

yet their potential husbands outnumber them by 18 percent, as shown earlier. In fact, the sex ratio between males aged 5–9 and females aged 1–5 as of 1990, the latter being the first cohort affected by sex-choice technology, is 127; but even if the "missing girls" were "restored," the sex ratio of this group would be reduced only to 122, suggesting that the contribution of selective abortion to the marriage squeeze is a mere 4 percent.

In actuality, age may be a minor factor in mate selection. It will be interesting to see how males aged 15–19 in 1990 cope with the shrinking pool of potential partners when they reach marriageable age. The age gap between spouses may increase; men may look for imported brides, as some young rural men currently do; more women may marry younger men; or an increasing number of men may choose celibacy. The majority of this group should be marrying around the year 2000. Their marriage behavior may provide us with clues about the behavior of subsequent cohorts that will face an increasingly imbalanced sex ratio.

Besides the marriage squeeze, a high sex ratio at birth has been speculated to have other negative consequences. If women become scarce, pornography and crimes of violence, especially such sex-related ones as rape and molestation, may increase (Ullman and Fidell 1989). Homosexuality may also increase, and polyandry may even develop.

On the other hand, a sex-selective society may have some positive aspects. If men have difficulty finding mates, women may eventually enjoy the benefits of increased value for conjugal and reproductive functions, and this in turn may lead to a better social position for them and eventually to more balanced sex ratios at birth. If more men choose to marry older women, there should be fewer single, lonely people in old age, given the longer life expectancy for women. Another positive consequence of selective abortion may be a reduction in the number of unwanted children. It has been demonstrated that postneonatal infant mortality in Korea is higher among females than males (Park and Park 1981). Probably this situation results at worst from the ill treatment and abuse of girls and at least from discrimination against them for being of the unwanted gender. Selective abortion will make more births those of "wanted children," lessening discriminatory treatment of females.

Changes in the sex ratio at the family and birth-order levels could also have serious social consequences. As we have observed, small families consist predominantly of boys, while large families consist predominantly of girls. This situation, if it continues, may widen the social gap between the positions of males and females in Korea. Children in large families tend to be disadvantaged in resource allocation, child care, education, and other social and psychological respects, compared with children in small families. In such families daughters, who are already discriminated against for traditional reasons, are worse off than sons. Blake (1981, 1989) argues that family size is inversely and importantly related to child "quality." Terhune (1974: 81), reviewing the Western-focused literature on the consequences of family size, concludes that children from small families are generally "more ambitious, more independent, more socially outgoing, more popular, more dominant, and with higher self-esteem than others." He also notes that members of large families "are more prone to antisocial behavior, delinquency, and criminality" (p. 99). These findings, however, may not hold in developing societies. In Korea siblings appear to rely on one another far more than do siblings in Western cultures. Korean parents generally perceive large families much more positively, at least until very recently (Lee and Kim 1979).

The high sex ratio of later births and of last-born children may also have important social consequences. Many psychologists have studied the effects of birth order on the development of children. For instance, Abraham and Prasanna (1983) show that a first-born child has better health than do children of late birth orders. Retherford and Sewell (1988) argue that intelligence and birth order are negatively related. Falbo (1981) finds higher self-esteem and achievement orientation in first-born children, but Klein (1984) asserts that they are more self-centered and introverted. Unfortunately, reports often conflict regarding advantages and disadvantages of different birth orders and family sizes. Nevertheless, it appears that birth order does play a role in child development, however small the effect may be.

Findings from Western societies may not be applicable to traditional Asian societies. What we emphasize with respect to differential sex ratios by birth order is the traditional social and familial responsibility associated with males. In Korea the first-born male is highly valued as the person who is expected to continue the family line. A wife's position is secure if her first child is a boy. Under these circumstances, a first-born son will receive the best possible care and education; a first-born daughter will be less fortunate. A daughter is expected to sacrifice her own education and other benefits for later-born brothers. If a family is not well-to-do, she may even have to earn money under adverse conditions to help pay for the education of her younger brothers. As a rule an older brother is not expected to sacrifice his education and other opportunities for his younger sisters. Moreover, when parents are young, their financial situation is usually less secure than in later life; elder children, regardless of their gender, are likely to have fewer advantages than later-born children.[11] The increasing sex ratio with higher birth orders is disadvantageous to females.

As we showed in Table 8, the last child is far more likely to be a boy than a girl. It is a truism in Korea that the last-born child, whether male or female, is the most pampered. Thus, Korean boys may have better chances for education and be cared for better than girls, but they may have problems in socialization. The same may be said of an only child, who is also more likely to be a boy. A common Korean warning is "Don't let your daughter marry an only son," because such sons are regarded as very selfish. More research is needed on the family-level implications of son preference in low-fertility societies.

Medical and health implications

Three technologies are currently used to determine the sex of a fetus. Chorionic villus sampling can be successfully performed at eight to twelve weeks of pregnancy. Because this method is very expensive, only a small number of people can afford it. Amniocentesis is frequently used; but the test is applicable only after 16 weeks of pregnancy, and it requires another three to four weeks for the laboratory test to determine the sex of the fetus. Thus, a selective abortion based on the result of this technology cannot be done in the first trimester. Furthermore, amniocentesis is not always safe; although rarely, a fetus can be injured during the procedure. The most often used method in Korea appears to be ultrasound. It is the least expensive and simplest method, but it is effectively applicable only in later stages of pregnancy. Ultrasound is performed even at private clinics, but considerable skill is required for an accurate reading. Its diagnostic specificity and sensitivity in such settings—measures for false positive and false negative findings, respectively—are not known.

It is widely known that induced abortion, while safer than childbirth, can be dangerous, even fatal, to a woman, and an aborted fetus may be viable if the abortion is performed during the second or third trimester of pregnancy. We have not been told of any morbidity or mortality of women or infants arising from these technologies or from late abortion. If there has been none, it must be at least largely attributed to the excellence of Korean medical technology. Among the positive health aspects of sex-selective abortion, the application of medical technology to determine the sex of a fetus increases the likelihood that a pregnant woman will receive antenatal care and that any fetal anomalies will be discovered, thus contributing to better maternal and child health. Indeed, sex determination can be a byproduct of tests performed for health or genetic reasons.

Economic implications

For each selective abortion more than two tests of sex determination must be performed, as there are more male than female fetuses and not all parents of female fetuses opt for abortion. Thus if 15,000 selective abortions are performed in a given year, there must have been more than 30,000 medical tests.[12] Because Korean law prohibits testing to determine the sex of a fetus and a harsh penalty is imposed for its violation, the technologies for doing so are used clandestinely. The cost appears to vary tremendously depending upon the person or institution performing the test. The most complicated and reliable technique, chorionic biopsy, may cost more than half a million won (US$625). Amniocentesis costs less but is not inexpensive. In 1984 a weekly popular magazine (*Joongang Weekly*, US issue, 17 June 1984) reported it cost 200,000–300,000 won ($250–$375). The simplest and most commonly used technique, ultrasound, costs about 60,000 won ($75). If 35,000 tests were performed annually and every case used ultrasound, the total cost would exceed $2.6 million per year. Added to this would be the costs of abortion, when chosen, and aftercare.[13]

On the other hand, these technologies are not used solely for sex determination. The main reasons may ostensibly be for the detection of genetic disorders and other health-related concerns. In an interview with a reporter, however, a board-certified obstetrician stated that in 90 percent of cases the objective of amniocentesis is sex determination (*Joongang Weekly*, US issue, 17 June 1984). We cannot give any creditable estimate of the cost of applying sex-choice technology, but it would be millions of dollars per year.

Discussion

Many demographers and population planners have considered parental preference for sons in East Asian countries to be a major barrier to reducing fertility. Yet some of these countries, such as Korea and China, have achieved replacement-level fertility despite their societies' strong adherence to son preference. These countries now show evidence of changes in the sex ratio at birth at three levels—in the population at large, between families, and within families—and probably those changes have occurred to accommodate preference both for sons and for the small-family norm. In this article we have presented evidence of such changes in Korea and other East Asian countries and discussed their demographic, social, medical and health, and economic implications.

The fertility impact of son preference appears to be closely related to family size norms and to the availability of contraceptive and sex-choice technologies. When large family size is the norm, son preference probably does not matter, as couples keep bearing children anyway, whether they prefer a son or not. When the family size norm is moderate and only contraceptive methods are available, son preference can play an important role in deciding whether to stop or to continue childbearing. In a society with son preference, at the arrival of each baby, couples may "calculate," consciously or unconsciously, the sex distribution of their children and decide whether or not to accept family planning, weighing their need of another son against their desired family size. When the family size norm has become small, by choice or coercion, son preference distorts the sex ratio of children through the use of sex-selection technology or some other means, such as failure to report female births or selective infanticide at the extreme.

The rising aggregate sex ratio in the population of China has drawn considerable attention in recent years. Male dominance in substantial numbers in young adult life, now a distinct possibility in the near future in some Asian countries, may bring serious consequences, although not all of them negative. In the short term sex-selection technology is likely to reduce family size and increase the proportion of births that are "wanted," and in the long run a high sex ratio at birth may improve the position of females. Traditional societies are likely to come to value women more highly.

Little concern has been expressed about the implications of sex-ratio distortion at the family level. The clear inverse relationship between family size and the sex ratio, sharply rising sex ratios with birth order, and the extremely high sex ratio of last-born children in low-fertility East Asian countries, Korea in particular, may bear important social implications. Generally speaking, these situations do not seem to be favorable to Oriental women, against whom discrimination is already common. New research is required to study the effect on the value and wellbeing of boys and girls of sex-ratio imbalances at the levels of family size and birth order.

The sudden increases in sex ratios in East Asian countries are impressive—in each country, within a single year the sex ratio has jumped to a high level that has subsequently been sustained. This suggests that people have been anxiously awaiting the availability of sex-control technology. In fact, there is evidence that couples actively use such technology, regardless of fertility level. In India, a country with relatively high fertility, the sex ratio increased from 105 to 122 between 1981 and 1988 among births in hospitals and "nursing homes" in Ludhiana City that provided intranatal services, and 7999 out of 8000 aborted fetuses in Bombay were female (Sachar et al. 1990). In one hospital in a city of Western India, 430 out of 450 fetuses identified as female were medically terminated while none of 250 fetuses identified as male was terminated (Ramanamma and Bambawale 1980). Patel (1989) states that sonography, fetoscopy, "needling," "chorion villa biopsy," and amniocentesis have become household words in urban India and claims that Bombay and Delhi are the major centers for sex-determination and sex-preselection tests. In 1982 the Indian Democratic Women's Organization called for a government ban on amniocentesis, saying that the test was used as a basis for abortion of female fetuses.

On 31 January 1990 Korea's Ministry of Health and Social Affairs suspended the medical licenses of eight physicians who had performed sex-determination tests on fetuses, an action that was widely reported in the media. In May of the same year the ministry amended the regulations on medical care so that medical licenses could be revoked for performing sex-determination procedures. Some believe that this action has effectively eliminated sex-selective abortion. In fact, birth registration data showed a considerably lower sex ratio at birth in 1991 than in 1990, down to 112.9 from 116.9. Some observers, however, believe that the harsh regulations would only raise the clandestine service of sex determination. They claim that the decline in the 1991 sex ratio in the registration data is artificial. In Korea girls born in the Year of the Horse (one of the 12 years in the Chinese zodiac cycle) are popularly believed to be destined for misery. The year 1990 was a Horse Year, and many girls born in that year may have been registered as born in 1991 to avoid suffering the stigma of being born under the zodiac sign of the Horse. One may note that the 1992 sex ratio of 114 lies between the rates of the previous two years. Trends in the sex ratio at birth in low-fertility Asian countries with son preference, such as Korea, need to be watched closely in the next few years.

Notes

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1 For instance for Asia alone, in Bangladesh (Ahmed 1981; Bairagi and Langsten 1986; Amin and Mariam 1987; Chowdhury and Bairagi 1990; Rahman et al. 1992; Rahman and DaVanzo 1993), China (Arnold and Liu 1986; Wen 1992, 1993), India (Das 1987; Kumari and Rao 1983), South Korea (Arnold 1985; Park 1978, 1983), and Pakistan (Khan and Sirageldin 1977; De Tray 1984; Ali 1989).

2 Although some success is reported regarding sex preselection (e.g., Khatamee et al. 1989), we do not believe the technology is used to the extent of altering the sex ratio at birth.

3 Korea's reported sex ratios prior to 1945 were consistently and unusually low. A possible explanation is high fetal mortality, which claims far more male than female

lives. Unfortunately, we do not possess reliable data on fetal mortality for that period: but studies show that infant mortality in the 1920s exceeded 200 per thousand live births (Mizushima 1938), and at the turn of this century fewer than 50 percent of births resulted in surviving children at age five (VanBuskirk 1927).

4 For instance, see Arnd 1990; Banister 1992, Coale 1992; Johansson and Nygren 1991; Gu and Peng 1992, Hull 1990, Zeng et al. 1993; and Wen 1992, 1993.

5 Using vital registration data for Japan, Imaizumi and Murata (1981) reported an extremely gradual increase in the sex ratio at birth between 1900 and 1978, with no sudden increase in more recent years. They conclude that "a suspected reason for this change is the shift in the distribution of births by age of father, age of mother or birth order."

6 A negative relationship between the secondary sex ratio and birth order is a well-established observation among biologists, but the relationship is so weak that the variation is not demonstrable with a moderate sample size. Teitelbaum, Mantel, and Stark (1971) suggest that in a study involving fewer than half a million births it would be difficult to detect the birth-order effect on the sex ratio.

7 Although there has been a gross underregistration of vital events in South Korea, in recent years the completeness of registration has improved greatly. Nevertheless, some degree of delayed registration is believed to exist. Because evidence of birth is required at the time a child is enrolled in school, virtually all births are believed to be reported by age six, except for some children who die before reaching the age of school registration. Therefore, slight changes in the reported sex ratio are likely to occur for recent years.

8 To show the relationship between family-size distribution and birth-order-specific sex ratios, it is algebraically more convenient to use the probability of male births than to use the sex ratio itself. Let p_{ij} be the probability of a male birth in the i-th birth among women of family size j, and let n_j be the number of women with family size j. Then the overall probability of a male birth in the i-th birth order p_i is

$$\frac{\sum_j n_j p_{ij}}{\sum_j n_j}.$$

As is obvious, p_i is a function of n_j and p_{ij}. Then, for a given set of p_{ij}, the value of p_i depends on the distribution of n_j; similarly, for a given set of n_j, the value of p_i depends on the distribution of p_{ij}.

9 According to the 1990 census, only 2.2 percent of ever-married Korean women with completed fertility had more than five births.

10 *Joongang Daily*, for instance, predicted in its 11 June 1984 issue that there would be a "bride famine" in ten years, and predicted in its 13 December 1985 issue that in the early 2000s 2.25 million eligible men would be competing for marriage to 1.8 million eligible women. It carried an editorial on this topic in the 14 December 1985 issue.

11 Later-born children may be disadvantaged because of competition for resources when there are more children.

12 A reviewer points to allegations in some countries that doctors often report male fetuses as female fetuses, so that they can make more money by performing an abortion. We are not aware of this type of practice in Korea.

13 Of course, there are costs in carrying a pregnancy to term and in childbirth itself, to say nothing of the costs of raising the child. On the other hand, if there were no sex preference, pregnancy itself might have been avoided.

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