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Gender Preference and Sex Imbalance in the Population and Their Implications in Korea

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Ⅰ. Introduction

Central to the concern of demographers and population planners has been its impact on family size of parental preference for sex of children, especially in patriarchal developing societies in Asia. If parents continued to bear children until they reached to the desired sex combination of children or 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 if couples continued childbearing until two sons were born. In fact, abundant empirical evidence that show close relationships between sex preference and fertility, for instance, in Bangladesh (Ahmed 1981;Bairagi and Langsten 1986;Amin and Mariam 1987;Chowdhury and Bairagi 1991;Rahman et al 1992; Rahman and DaVanzo 1993), China (Arnold and Liu 1986;Wen 1992), India (Das 1987; Kumari and Rao 1983), Korea (refers to South Korea throughout the paper) (Arnold 1985;

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Park 1978, 1983), and Pakistan (Khan and Sirageldin 1977;De Tray 1984;Ali 1989).

In some East Asian countries, such as China and Korea, fertility has recently declined to the level of replacement or even below replacement level, in spite of their strong adherence to the attitude of son preference. In these countries, however, probably to accommodate both sex preference and small family, a new demographic phenomenon of distortion of sex ratio (number of males per 100 females) at birth is emerging in three different levels:in the general population, within the family, and in the birth order, or aggregate, between family and within-family levels. At the aggregate population level, a rising trend has been recorded in the sex ratio. At the family level, depending on the size of family markedly different sex ratios have been observed, large families presenting low sex ratios and small families high sex ratios. At the birth order level, a rapidly rising sex ratio is reported with birth order. For a given family size, the sex ratio of the last born children is extremely high.

In this paper we present empirical evidence for these changes in the sex ratio, focusing mainly on China and Korea. Then we discuss possible demographic, social, health and other implications of the changes, using the case of Korea.

The principal means of altering the sex ratio at birth, also known as secondary sex ratio, are four-fold:sex-selective abortion, differential contraceptive use depending on the sex distribution of existing children, female infanticide, and not reporting female births. Differential contraceptive use alone will not alter the population sex ratio nor cause variations in the sex ratio among birth orders, as long as the probability of a male birth is constant across birth orders. Use of contraceptive technology, however, can change family-size-specific sex ratios. It can alter the sex ratio of the last-born child, given family size (Park 1983). In a strict sense, differential child mortality by sex, including sex-selective infanticide, may produce a distortion of the sex ratio in early childhood rather than at birth. Finally, false reporting, for instance, hiding female births as a consequence of coercive fertility reduction program, will cause statistical artifacts showing abnormal recorded sex ratios at birth. The last two means are probably used mainly in China.

Ⅱ. RECENT CHANGES IN SEX RATIOS AT BIRTH

1. Sex ratio of the aggregate population

Table 1 presents the recorded sex ratios of children at birth by each single year of age through age four for China, Taiwan, Korea and Hong Kong, the East Asian countries that have recently attained low level fertility. The ratios represent the sex ratios of recorded survivors to the ages shown. 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 in these ages slightly exceeds female mortality. In a strict sense the sex ratio at birth should be slightly larger than the recorded ratio and the discrepancy between the two sexes should decrease

Table 1. Recorded sex ratio of children under five years of age: China, Korea, Hong Kong, selected years

Age	0	1	2	3	4
China[1]					
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[2]					
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[1]					
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[1]					
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

Note: The sex ratio equals the number of males per 100 females.

Sources: 1) census reports.

2) Taiwan-Fukien Demographic Fact Book.

with age. Nevertheless, by and large the recorded sex ratios of young children under age five may be regarded to reflect the general level of sex ratio at birth.

It appears that in all four areas during the 1980s, and more specifically after about 1985, the sex ratio at birth began to rise. There is no evidence before that time of anomalous sex ratios, each area conforming to the world average of 106+. In the case of China a marked increase was noted for children under age four only in the year of 1990, implying that the sex ratio had risen beginning about 1986. The increase in China's reported sex ratio has attracted considerable attention recently. 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 from about 107 to 110 or more. In addition, a considerable rise occurred for age zero in 1985. In Hong Kong there is evidence that sex ratio of children under three years of age rose in 1991. In contrast, census reports for Japan, a country with no known sex preference, no such increase in the sex ratio of young children.

This sudden rise in the recorded sex ratios of young children is a totally new trend in the long series of demographic data for these countries. It may be due to either real changes in the secondary sex ratio or to the intentional hiding of female births. We do not consider it to be statistical variations or of an unintentional overcounting of boys or undercounting of girls. Prior to the rise, the observed sex ratio remained entirely within the normal range and its level was stable. Except for Hong Kong, the population size is sufficiently large to make role of random fluctuations negligible. The sex ratios of survivors of the same birth cohorts present consistent levels.

In Taiwan children under one year of age in 1987 were the first group to show a rise in the sex ratio. The survivors of this and subsequent cohorts show similarly high sex ratios in later ages〈Table 1〉. As shown in Table 2, in Korea the survivors of the age group 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.

It also appears that geographical area plays a role in the variation in sex ratios, at least in Korea. As Table 3 shows, the sex ratio of young children is uniformly high, irrespective of the size of the community, whether it be a large city or small town or rural area. Among the six metropolises with populations of more than one million, however, one city in particular (Taegu) records extremely high sex ratios ranging from 122 to 130. Even the rural area surrounding this city has very high ratios(data not shown). This area, which produced three generals who have ruled the country ruthlessly for the past 30 years, is generally considered to be very conservative, having a strong parochial tie popularly known as the TK (Taegu-Kyungsangpuk Province). Although the sex ratio of the rural areas is high, their rising trend appears to have lagged some years behind that of urban areas, the level above 110 being observed for children born in 1988 and afterward. These observations seem to indicate that the recent rise in the sex ratio of children in not due to random variations.

Table 2. Sex ratio of children under five years of age in 1985 and their Survivors in 1990:Korea

Age in 1985	Sex Ratio	Age in 1990	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 3. Sex ratio of children under five years of age, by single years of age and by administrative area:Korea, 1990

Administative area	Age				
	0	1	2	3	4
Entire country	112.5	111.6	111.2	109.3	111.4
Cities (total)	112.3	111.6	111.5	109.5	111.9
Cities over 1 million population					
Seoul	109.9	108.8	110.4	109.8	111.8
Pusan	114.1	112.7	110.5	108.4	112.6
Taegu	124.0	125.8	130.2	121.7	124.7
Inchun	108.4	107.5	106.5	106.7	107.8
Kwangju	110.8	108.4	105.7	107.8	107.4
Taejun	118.4	119.8	116.3	111.2	112.0
Towns (Eup)	111.1	112.4	109.2	109.5	110.8
Rural (Myun)	115.3	111.4	110.3	107.9	108.8

Source:census reports.

Sheps (1963) has shown theoretically that the use of contraceptives does not alter the population sex ratio at birth, whereas the other three factors-selective abortion, infanticide and hiding female births-can distort the aggregate sex ratio. Although some scholars have hypothesized the wide spread practice of female infanticide (Aird 1990, Johansson and Nygren 1991), a recent analysis by Zeng et al.(1993) finds that underreporting of female births and sex-selective induced abortion can explain almost all of the increase in the reported sex ratio at birth during the late 1980s. It is a reasonable finding ; it is hard to imagine that half a million or

more missing female children (Hull 1990) are killed each year to meet the reported sex ratio levels although the government strongly enforces its one-child family policy and a penalty is imposed on couples who bear a second child yet Chinese couples need sons to support them in old age, to carry on the family name, and to inherit property. To have a legal chance of bearing a boy, many couples who have borne female babies may not report those births. Implications of China's rising population sex ratio are discussed by Hull (1990) and by Zeng et al. (1993).

Unlike the situation in China, in Taiwan and Korea selective abortion appears to be the primary cause of rising sex ratios. There is no reason to suspect statistical artifacts in the reported sex ratio owing to female births being hidden in these countries because neither a coercive regulation of fertility nor an abrupt change in the family planning program has occurred there. I 11 treatment of baby girls, as compared with baby boys, is possible;but overt sex-selective infanticide is beyond imagination. The recent rise of sex ratios in Korea and Taiwan must therefore be considered as real. Korean census reports suggest that the rise there began taking place in 1985 or 1986. Other independent sources of information corroborate this observation. According to the school-enrollment statistics (Ministry of Education 1992), as of April 1992 first graders presented a sex ratio of 109. 1, the second graders 107.6 and all upper class pupils one in the vicinity of 106. A great majority of the first graders in that year were children born in 1986. Although there may be some mortality differentials disfavoring female babies owing to discrimination against them, such an effect on the sex ratio should be negligible and we do not believe that a sudden increase in discrimination occurred with the birth cohort of 1986. As we show later, birth registration data also indicate a sudden jump in the sex ratio starting in 1985.

2. Family-size-specific sex ratio.

Table 4 presents sex ratios of children at birth, by family size, for China and Korea. It is apparent in recent years that sex ratio has dropped as family size increased. The 1985 China Indepth Fertility Survey shows that in two provinces with vastly different degrees of development, the sex ratio declined abruptly from 130 to 108, if family size reached three children. The Korean data also demonstrates a sex ratio transition by family size. In the period before contraceptive use was widespread (1929-40), the sex ratio did not vary with family size ; but in the early years of the country's population program (1966-1974) a sudden decline in the sex ratio occurred between the family sizes of three and four children. In 1991, when fertility reached a below replacement level, the sex ratio declined systematically and precipitously as family size increased. Although this trend is clear for all the sample and for women of ages 35-44 with completed fertility, it is far more pronounced in the latter group. It may be said that when fertility is in a transitional stage, there is a threshold of family size below which sex ratio is very high but above which the sex ratio drops abruptly. If fertility completes its transition, however, the threshold disappears and a clear negative association be-

Table 4. Sex ratios at birth, by family size: China, 1985, and Korea, 1929-91

Country	Family size				
	1-child	2-child	3-chid	4-child	5-child
China[1]					
Hebei Province	122.9	130.0	108.8		
Shaanxi Province	120.3	131.1	108.5		
Korea[2]					
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 (all sample)	135.7	135.4	102.7	86.6	58.6
1991 (completed fertility)	206.9	159.8	103.2	78.4	49.0[a]

Sources: 1) 1985 In-Depth Fertility Survey (adapted from Wen 1992)

2) 1929-1940: Keijo 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; completed fertility is for births to women 35-44 years of age.

a. for the first four children only

tween the sex ratio and the family size emerges. Note in the last row of Table 4 the remarkable contrast between one-child families, which have a ratio of below 50. The declining sex ratio with family size has been noted earlier by Park (1983). Not only selective abortion but also differential contraceptive use can cause this kind of imbalance, if couples who happen to bear daughters in their early married lives tend to continue childbearing, while those who happen to bear sons early in their marriages are motivated to stop.

3. Birth-order-specific sex ratio

The sex ratio at birth has been positively associated with birth order in Korea and China in recent years, as shown in Table 5. 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. This increasing ratio with birth order is easily explained : if family size must be limited in a society with strong son preference, beyond a certain number of births the birth of female babies must be suppressed so that the desired number of sons may be attained within the family-size norm.

Table 5. Sex ratios at birth by birth order : China and Korea, recent years

Year	Birth order					
	Total	1	2	3	4	5+
China						
1981[1]	107.8	105.3	107.2	113.1	115.5	109.5
1982[2]	107.2	106.5	105.0	109.4	113.8	110.3
1983[2]	107.7	107.5	107.2	108.2	105.4	113.3
1984[2]	108.3	102.1	113.6	112.6	116.8	128.3
1985[2]	111.2	106.1	116.1	114.3	126.5	116.6
1986[2]	112.1	105.2	116.8	123.2	125.0	124.3
1986[3][1]	113.6	107.9	116.6	119.2	130.7	126.0
1987[2]	110.8	106.7	112.6	118.9	118.1	125.6
1989[4]	113.8	104.9	120.4	124.6	132.7	129.7
Korea						
Vital statistics data (current births)[5]						
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	
Survey data (retrospective births)						
1974[6]	106.5	107.3	107.8	110.7	105.0	103.8
1991[7.a]	107.9	110.1	102.7	113.4	113.3	101.2
1991[7.b]	110.8	117.9	98.5	115.6	126.7	

Sources: 1) China's One per 1,000 Survey (Coale 1992).
2) China's Two per 1,000 Survey (Coale 1992).
3) Hull (1990).
4) 1990 Census of China(Coale 1992).
5) National Statistical Officeof Korea
6) World Fertility Survey (adapted from Park 1983).
7) 1991 Fertility and Family Health Survey.
a) All sample.
b) For births to women 35-44 years of age (completed fertility).

As in the case of family-size-specific sex ratio, the time trend of birth-order-specific sex ratio is also well-demonstrated by the Korean registration data. Vital statistics show that prior to 1981 no specific association was recorded, 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 it appears that a systematic rise in the sex ratio took place with birth order following the abrupt rise. The data of 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, did not show any particular trend in the relationship between sex ratio and birth order. The picture was totally different, however, with the 1991 survey data. There was a sharp drop in the sex ratio of second-order births, but all other birth orders 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. In any case, a varying sex ratio according to birth order cannot occur by differential use of contraceptives alone, if one assumes the equal probability of male births across birth orders. There must be some kind of artificial manipulation to control gender. In case of Korea that artificial manipulation is selective abortion.

The high sex ratio of firstborn 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. Fidell et al.(1979) report that in a large sample of U.S. university students 85 percent wanted a boy to be born first and 73 percent a girl to be born second. Similar findings are also reported elsewhere (Markle and Nam 1971;Markle and Wait 1976). This American preference for "first son and second a daughter" may also be prevalent in Korea. Among Korean couples with completed fertility, the sex ratio of the secondborn 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.

We present the sex-sequence-specific ratios for 1974 and 1991 in Table 6. Statistical tests on the ratios show that in the 1974 survey data none of the 15 sex ratios of children following specified sex sequences in the earlier births was significantly different from the level of 107. On the other hand, in the entire smaple for 1991 the sex ratio of the thirdborn children following the sex sequence of female-female was significantly different from the 107 level. Among women with completed fertility, for whom the sample sizes were much smaller, significantly higher than normal sex ratios were noted with the first-order birth, the third-order births following two female births, and the fourth-order birth following three female births. It appears

Table 6. Sex ratios at birth, by birth order following specified sex sequences, Korea, 1974 and 1991

Birth order	Preceding sex sequence	1974		1991			
				All sample		Completed fertility	
		N	Sex ratio	N	Sex ratio	N	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*

Sources: 1) Korean World Fertility Survey.

2) Fertility and Family Health Survey.

M: male; F: female.

* Difference from 107 is statistically significant ($p<0.05$).

that if selective infanticide and hiding of baby girls are not operating in Korea then selective abortion is producing these particular orders of pregnancy.

A further examination of the sex-ratio distribution by birth order suggests an intricate consequence of the combined preference for sons and for small families. Tabulation of sex ratios by birth order and family size presents a similar picture for Korea and China and for either incomplete or completed fertility: that is, a clear negative correlation between sex ratios and family size in low birth orders and extremely high sex ratios for the last-born children, regardless of family size (Table 7). With these common features, why is the Korean sex-ratio distribution by birth order so different between 1974 and 1991, as seen in Table 5? It is a joint consequence of changes in the family-size distribution and differential selective abortion by

Table 7. Sex ratios at birth, by birth order and family size: China, 1985, and Korea, 1974 and 1991

Family size	N	Sex ratio by birth order				
		First	Second	Third	Fourth	Fifth
Korea: 1974[1]						
One	714	114.4				
Two	831	119.3	133.4			
Three	928	125.8	119.9	145.5		
Four	842	102.4	99.0	98.1	130.0	
Five	647	97.3	102.8	97.3	94.9	121.6
Six+	1016	90.3	91.0	104.0	93.9	93.9
Korea: 1991 (All sample)[2]						
One	1374	135.7				
Two	3129	130.1	140.9			
Three	1441	90.6	72.8	165.4		
Four	585	65.7	70.1	76.7	158.8	
Five+	328	54.7	43.9	43.2	62.4	101.2
Korea: 1991 (Births to women aged 35-44)[2]						
One	221	206.9				
Two	1238	158.4	161.2			
Three	869	101.6	66.2	164.1		
Four	309	54.5	60.9	67.0	166.4	
Five+	133	49.4	40.0	41.5	68.4	
China: 1985, Hebei Province[3]						
One	740	122.9				
Two	1488	124.1	136.2			
Three	1017	105.4	91.9	133.2		
Four	583	81.6	87.4	99.6		
Five	263	96.3	67.5	85.2		
Six+	136	94.3	54.5	76.6		
China: 1985, Shaanxi Province[3]						
One	711	120.3				
Two	1019	122.0	140.9			
Three	854	111.4	105.8	149.7		
Four	609	93.3	114.6	99.0		
Five	285	99.3	90.0	87.5		
Six+	148	75.0	68.0	95.3		

Sources: 1) 1974 World Fertility Survey (adapted from Park 1983).

2) 1991 Fertility and Family Health Survey.

3) In-Depth Fertility Survey (adapted from Wen 1992).

birth order and sex sequence. In 1974 fully one-third 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 children. In 1974, 31 percent of women had one or two births ; but 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. The peculiar distribution of the 1991 birth-order-specific sex ratio is 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 the last-born and the earlier-born are shown in Table 8.

Table 8. Sex ratios of last-born children and earlier children:Korea, 1974 and 1991, China, 1985

Country	Year	Family size	Sex ratio	
			Last-born	All others
Korea	1974	Two	133.4	119.3
		Three	145.5	122.8
		Four	130.0	99.8
		Five	121.6	98.0
	1991	(All sample)		
		Two	140.9	130.1
		Three	165.4	81.2
		Four	158.8	70.7
	1991	(Births to women aged 35-44)		
		Two	161.2	158.4
		Three	164.1	82.2
		Four	166.4	60.6
China	1985	(Hebei Province)		
		Two	136.2	124.1
		Three	133.2	101.6
	1985	(Shaanxi Province)		
		Two	140.9	122.0
		Three	149.7	108.5

Sources:Same as in Table 6.

Although differences are obvious between the two ratios within a given family size, they are relatively samll in two-child families but 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 the couples who have girls in the early stage of family building keep bearing children or abort female fetuses until a son arrrives.

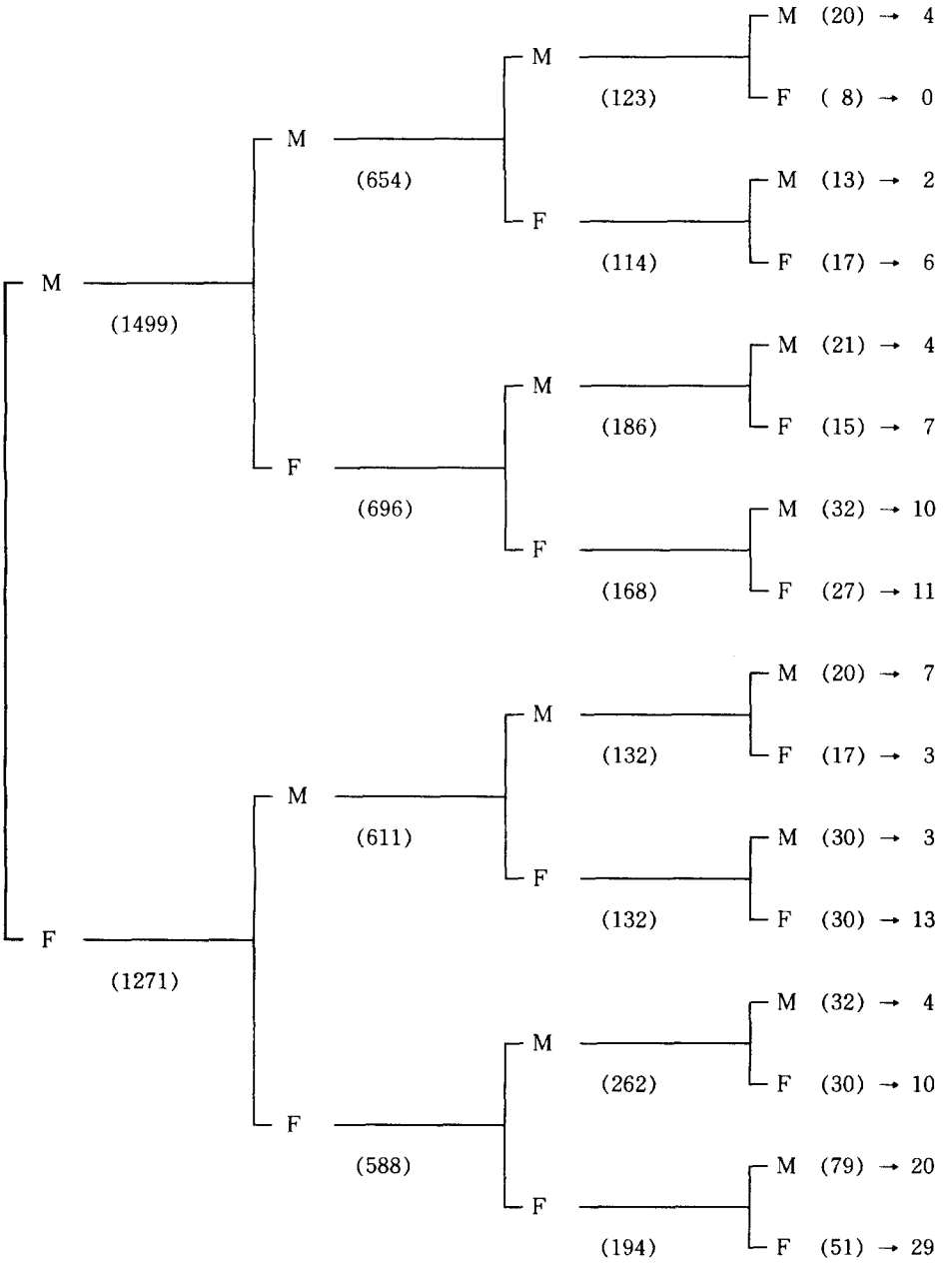
Ⅲ. IMPLICATIONS

In the face of these observations we now discuss the possible implications of sex ratio imbalances in a population and in the family. Depending upon the prevailing means used to alter the sex ratio, the implications can differ. Mainly because of our familiarity with the country and data availability, our discussion will focus on the Korean situation, which appears to be caused by selective abortion and selective contraceptive use. Although Hull (1990) has provided an excellent discussion of the implications of rising aggregate sex ratios in China, his study does not address the implications of imbalanced sex ratios in family or in birth-order levels.

1. Demographic implications

The rising aggregate sex ratio at birth in Korea raises two interesting questions related to its demographic implications. The first is:did the family size decrease because of artificial sex control? The second is:how many female births have been averted owing to selective abortion? To answer the 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 the first order births being 117.9 (1,499 vs. 1, 271). On the basis of the survey results we assume that 90.1 percent of women (1,350/1,499) 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 (1,199/1,271) will proceed to parity two, with a sex ratio of 103.9 (611/588). Thus, by using the last two columns of Table 6 we can model the growth of the family to birth order five, conditional on the gender of the preceding child. We assume, for simplicity, that family growth ends at birth order five;that is, that the maximum number of births per women is five. We assume further that this family-growth three reflects the presence of sex preferences and sex-choice technology. The family growth model under this assumption we call Model Ⅱ. If sex preference is operating without sex selection, the observed sex-specific parity-progression ratio should remain unchanged, as in Model Ⅱ;but at each stage of family building the sex ratio at birth will be held constant at 107, the normal level. This is our Model Ⅰ family-growth tree. We construct yet another family-growth model under the absence of sex preference (Model Ⅲ). In this case the sex ratio at each stage of family building is held constant, as in Model Ⅰ, but the lowest parity-progression ratio observed in Model Ⅰ at each stage will prevail regardless of sex composition; that is, family building occ urs in the absence of sex preferences.(Arnold 1985; Park 1986)

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



Once such a family growth model is constructed, the proportion of women in each parity is calculated and the expected number of births per lifetime per woman is easily derived. Summarized in Table 9 are the results of these models. As is evident, the reduction in the average family size owing to the sex-choice technology is negligible from the case of sex preference alone, average family size declining from 2.61 to 2.60. In contrast, the difference in the expected average family size is considerable between the sex preference and no preference models. One cautionary remark is due 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. We consider the absolute level to be somewhat lower, as we have assumed that every woman is fecundable in the models. On the other hand, the models assume the maximum number of children per woman to be five, the results being likely to be underestimates. Moreover, the model is based on the fertility experience of women aged 35-44 years in 1991. As sex-selective abortion has presumably become popular from around 1985, it is likely that the cohort is less exposed to selective abortion than the one presented here. The actual impact of selective abortion on fertility may be larger than the one presented. Whatever the real situation may be, family size under the presence of selective abortion must lie somewhere in the range between Model I and Model Ⅲ. We therefore consider the impact of the sex-choice technology on fertility to be moderate.

Next we turn to the second question. How many female births have been averted owing to selective abortion? The estimation of such numbers depends on the difference between the "normal" and observed levels of sex ratio, assuming no differential mortality by sex. Using the 1990 census report on the single-year population by sex, we can estimate the number of averted female births by dividing the reported number of males in the population by the "normal" sex ratio at birth minus the reported number of females in the population. Applying three levels of "normal" sex ratios, we have estimated the annual number of female births averted during 1986-90 〈Table 10〉. According to the medium-level estimation, (sex level of 106) the annual number of girls aborted appears to be be-

Table 9. Percentage distribution of completed families, by size, under three models

Model	1-child	2-child	3-child	4-child	5+-child	Av.fam. 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.

Table 10. Estimates of "missing" female births:Korea, 1986-90

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

tween 10,000 and 19,000, amounting to nearly 80,000 during the five years 1986-90. These missing girls represent about 5 percent of female births.

2. Societal implications.

The most popularly feared societal implication of rising population sex ratio appears to be the possible marriage squeeze in the future. Sensational reports have appeared in newspapers magazines warning of the future shortage of brides in the marriage market owing to rising sex ratio. The public is alarmed about this situation, as young rural men are already having difficulty finding wives because of the grossly imbalanced sex ratios in rural areas following the exodus of large numbers of young women to urban areas in search of employment and improvement of their lives.

Mate selection is a complicated issue but what is statistically recognized is that the age difference between husbands and wives is relatively constant. If age is the only criterion in selecting a mate and the current average age difference of four years between husbands and wives is maintained, the future imbalance in matching can be easily projected. If no mortality is assumed, males aged 20-24 as of 1990 should face little difficulty in finding their 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 (Table 11). 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 the males aged 10-14 in turn have to do the same when they grow up, the marriage market for the males aged 5-9 in 1990 will not be able to find their mates in the appropriate age range.

However, this would-be marriage squeeze has been caused more by rapidly declining fertility rather 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. Selective abortion wan uncommon when the girls aged 11-15 in 1990 were in fetal development, yet their potential husbands outnumber them by 18 percent, as we have already seen. 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

Table 11. Comparison of males in five-year age groups with females four years younger: Korea, 1990 census

Male		Femele		M/F (x100)
Age	Population	Age	Population	
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: Numbers in parentheses include "missing" girls.

reduced only to 122, suggesting that the contribution of selective abortion to the marriage squeeze is merely four percent. It appears that selective abortion may accelerate the marriage squeeze problem but its relative role is minor in comparison with the effect of declining birth rate.

In actuality, age may be a minor factor in the selection of a mate. It should be watched 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; or an increasing number of men may chose celibacy. The majority of this group should be marrying around 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, other negative consequences have been speculated about the high sex ratio. If women become scarce, pornography and crimes of violence, especially sex-related ones, such as rape, molestation, and pornography may increase (Ullman and Fidell 1989). Homosexuality may also increase and even polyandry may develop. Society could develop a "locker room" mentality (Ullman and Fidell 1989).

On the other hand, a sex-selective society might have some positive aspects. If men have difficulty in gaining access to women, 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. Another positive consequence of selective abortion is a reduction in the number of children with a "wrong" gender. It has been demonstrated that postneonatal infant mortality is higher among females than males in Korea (Park and Park 1981). We believe that this situation results at worst from ill-treatment, and abuse of girls and at least from discrimination against them for being of the "wrong" gender. Selective abortion will make more births "wanted children", closing the door to discriminative treatment of females.

Changes in sex ratio at the family and birth

order levels could also result in serious societal consequences. As we have observed, small families consist predominantly of boys, while large families 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 aspects, compared with children in small families. In such families daughters, who are already discriminated against for traditional reasons, than sons. Blake (1981, 1989) argues that family size is inversely and importantly related to child "quality". Terhune (1974 : 81), reviewing the 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 among abnormal personalities members of large families "are more prone to antisocial behavior, delinquencyl, and criminality (p.99)".

These findings, however, may not hold in developing societies. In Korea siblings appear to rely on each other far more than siblings in Western culture. Korean parents generally perceive large families much more positively, at least they have done so until very recently (Lee and Kim 1979). They consider that children from large families are more open and loving than are children from small families (89 percent vs.7 percent) but that those from small families are more close to parents than the others (83 percent vs.8 percent), (Lee and Kim 1979:Table 4.2). New studies are required to determine the effect on the value of boys and girls of Korea's rising sex ratio with declining family size.

A high sex ratio of later births and especially of last-born children may also have important social consequences. Many psychologists have studied effects of birth order on the development of children. For instance, Abraham and Prasanna (1983) show that a firstborn child has better health than do children of later birth orders. Retherford and Sewell (1988) argue that intelligence and birth order have a negative relationship. Falbo (1981) finds higher self-esteem and orientation toward achievement in firstborn children, but Klein (1984) asserts that they are more self-centered and introverted. Some advantages and disadvantages of given orders and differences among birth orders, however, have been found that appear to have social significance. It appears that birth order does play a role in child development, however small the effect may be. But findings from the Western societies may not be applicable to the traditional Asian societies.

What we would like to emphasize with respect to differential sex ratio by birth order is the traditional social and familial responsibility associated with the male sex role. In Korea the firstborn male child is highly valued and is the person who is expected to continue the family line. The position of a wife is secured if her first child is a boy. Under these circumstances, the first child, if it is a boy, will receive all the best care and education;but if it is a girl, that story may not be the case. A daughter is expected to sacrifice her own education and other benefits for later-born brothers. If 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. Individual cases vary, but 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, usually their financial situation is less secure than in their later life;elder children, regardless of their gender, are likely to have fewer advantages than later-born children. The increasing sex ratio with birth orders is disadvantageous to females.

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 one in the family. Thus, Korean males may have better chances for education and are cared for better than girls, but they may encounter more socialization problems than females. The same may be said of the only child in a family, 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 socities.

We opt not to estimate the maximum sex ratio produced by couples using the technology of sex choice. A maximum level will be a function of many related factors, such as the strength of son preference, the availability of the technology for sex predetermination, its actual use, financial, health and legal, and ethical considerations. Although the Korean sex ratio at birth is likely to remain higher than normal at least for the time being, some believe that the worst is already over because of the government's decision to punish medical practitioners who engage in sex predetermination. On 31 January 1990 the Ministry of Health and Social Affairs suspended the medical licenses of eight physicians who had performed sex-determination tests on fetuses, and the action was widely reported in the media. In May of the same year the ministry amended the medical-care regulations so that medical licenses could be revoked for performing the sex-determination procedure. Interesting, birth registration data show that the 1991 sex ratio at birth was considerably lower than that of 1990, down to 112.9 from 116.9. Some observers, however, believe that the harsh regulations have only raised the cost of the service and made sex-determination a clandestine procedure. Furthermore, some consider that the decline in the 1991 sex ratio suggested by the registration data is artificial. In Korea girls born in the Year of the Horse (one of the twelve years in the Chinese zodiac cycle) are popularly believed to destroy their husbands in the future. The year of 1990 happened to be Horse Year, and some believe that many girls born in that year were registered as being born in the following year to avoid their suffering the stigma of being born under the zodiac sign of the Horse. If that is so, the sex ratio for 1991 was artificially reduced and the worst is not over yet.

3. Medical and Health Implications.

Three technologies are currently used to determine the sex of a fetus. Not all of these can be applied in the early stage of pregnancy. The earliest applicable one is chorionic villi sampling, which can be successfully performed during eight to twelve weeks of pregnancy. Unfor-

tunately, this method is very sophisticated and expensive, and only a small number of people can afford it. Amniocentesis is frequently used; but the test is applicable only about 16 weeks of pregnancy, it further requires another three to four weeks for laboratory test to determine the sex of the fetus by counting chromosomes. 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 rare, a fetus can be even injured during the procedure. The most often used method in Korea appears to be the ultrasonar technique. It is the least expensive and simplest method but it is effectively applicable even later than amniocentesis. The method is performed even at private clinics, but considerable skill is required for an accurate reading. Its specificity and sensitivity in such settings, measures for false positive and false negative findings, are not known.

As is widely known, abortion 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 morbidity or mortality of women or infants due to these technologies and late abortion. If there has been none, it must be attributed to the excellence of Korean medical technology or pure luck. Of course, there are some positive health implications of sex-selective abortion too. The application of medical technology to determine the sex of a fetus, makes mor likely that a pregnant woman will receive antenatal care and that any anomalies of the fetus will be discovered, thus contributing to better maternal and child health. As a matter of fact, sex determination can be a by-product of tests performed for health and genetic reasons.

3. Economic Implications

It should be realized that 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. Because Korean law prohibits testing to determine the sex of a fetus and a harsh penalty is imposed for its violation, the technolgies for doing so are used only clandestinely. It is difficult to determine the cost of each method, and the cost appears to vary tremendously depending upon the person or institution that performs the test. The most complicated and reliable technique, chorionic biopsy, may cost more than half a million won ($625). Amniocentesis costs less but still is not an inexpensive procedure. In 1984 a weekly popular magazine, (Choongang Weekly US issue 17, June 1984) reported it to cost 200,000-300,000 won ($250-$375). The simplest and most commonly used technique, ultrasound, appears to cost about 60,000 won ($75). If we assume that 35,000 tests are done annually and every case uses the ultrasonic method, the total cost of the tests would amount to more than $2.6 million per year. Added to this, the costs of abortion and after-care must be considered.

On the other hand, these technologies are not used solely for sex determination. The main reasons may be ostensively for the detection of genetic disorders and other health-related con-

cerns. 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 (Choongang Weekly, US issue 17, June 1984). We cannot give any creditable estimate of the cost of applying of the sex-choice technology, but a wild "guesstimate" would millions of dollars per year.

Ⅳ. Summary

Many demographers and population planners have considered parental preference for sons in Asian countries as a major barrier to reducing fertility. Nevertheless, some East Asian countries, such as Korea and China, have achieved replacement level fertility notwithstanding their societies' strong adherence to son preference. These countries now show evidence of changes in the sex ratio at birth in three levels-in the population at large, in the family, and in birth orders-and those changes are probably due to preference for sons and small-family norm, by preference or coersion. In this paper we have presented evidence of the changes in Korea and China and discussed their demographic, social, medical and health, and economic implications. The principal means used to alter sex ratios are sex-selective abortion, differential contraceptive used according to the sex distribution of children within a family, selective infanticide, and hiding female births. The last two means probably operate only in China.

The Asian countries that have recently achieved low fertility show rising sex ratios at birth since about 1985. In Korea, moreover, certain geographicl areas present unusually high sex ratios in recent years. An inverse relationship is now observed between the sex ratio and family size, suggesting that parents who have had sons in their early reproductive lives tend to stop childbearing early but those who have had daughters tend to continue. The sex ratio of siblings jumps at a certain birth order, implying parental manipulation of gender beyond the acceptable family size. For a given family size, whether small or large, the sex ratio of the last-born children is extremely high, indicating a parental tendency to stop child bearing when a son arrives.

The decrease in family size as a consequence of artificial sex control in Korea appears to be negligibly small when the family-building process is patterned for couples with completed fertility. Average family size would decrease from 2.60 to 2.30 children, an 11 percent decline, however, if sex preference were to disappear. By our medium-level estimation, during 1986-90 about 76,000 female births were averted by selective abortion in Korea, corresponding to about 5 percent of all potential female births.

A marriage squeeze due to the imbalanced sex ratio is popularly feared. If one assumes that the customary age difference of four years between a husband and wife is the only criterion for mate selection, then it follows that when girls aged 1-5 years in 1990 (the first age cohort subjected to sex-choice technology) reach marriageable age, about 50 percent of their potential husbands will face a shortage of brides. This situation results largely from declining fertility, however. Another likely consequence of the imbalance in the family-size-specific sex ratio is that girls will be further disadvantaged

in education, childcare, and opportunities, because large families, whose resources are generally more stretched than those of small families, are composed predominantly of girls and small families predominantly of boys. On the other hand, boys may encounter more problems of socialization than girls, as the last-born child and the only child, who are known to be very pampered in Asian societies, are likely to be boys.

The safety of selective abortion can be a serious problem, particularly since the sex determination of fetuses is done mostly by means of the relatively inexpensive ultrasonar technique, which is not effectively applicable until the second trimester of pregnancy. The medical costs of sex determination and subsequent abortion can be substantial, especially if couples rely on more sophisticated techniques than the ultrasound method. Recently, selective abortion has become a controversial social and ethical issue. In Korea harsh regulations against the procedure have been enacted, making some believe that the worst is over. Trends in the sex ratio at birth in the low-fertility Asian countries will need to be watched closely in the next few years.

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1. Although some degree fo success is reported regarding sex preselection (Khatamee et al. 1989), we do not believe the technology is used to the extent of altering the sex ratio at birth.
2. Korea's ratios prior to 1945 were consistently and unusually low. A possible explanation for this observation was high fetal mortality, which claims far more male than female lives. Unfortunately, we do not possess reliable data on fetal mortality of that period; but studies show that infant mortality in the 1920s exceeded 200 per 1,000 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), implying extremely high fetal death rate.
3. For instance, see Aird 1990, Banister 1992, Coale 1992, Johansson and Nygren 1991, Gu and Peng 1992, Hull 1990, Zeng et al. 1993.
4. 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, but there has been no sudden increase in recent years. Imaizumi and Murata suggest that a change in birth order distribution and a decrease in the stillbirth rate can explain part of the increase in sex ratio, but the true cause of the secular trend in the secondary sex ratio may be found in a very early stage of pregnancy or at the time of conception.
5. 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 et al.(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.
6. 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. As 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, excrpt for some births of 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.
7. 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 rather than to use the sex ratio itself. Let pij be the probability of a male birth in the i-th birth among women of family size j, and let nj be the number of women with family size j. Then the overall probability of a male birth in the i-the birth order pi is. As is obvious, pi os a function of nj and pij. Then, for a given set of pij, the value of pi depends on the distribution of nj, and, similarly, for a given set of nj, the value of pi depends on the distribution of pij.
8. According to the 1990 census, only 2.2 percent of ever-married Korean women at the completed fertility ahd more than five births.
9. Choongang Daily, for instance, predicted in its 11 June 1984 issue that there would be

"bride female" in ten years, and in its 13 December 1985 issue predicted that in the early 2000s 2.25 million eligible men would be competing for marriage to 1.8 million eligible women. It carried and editorial on this topic in the 14 December 1985 issue.