韓國人口學會誌 第十七卷 第二號 (1994)
The Journal of The Population Association of Korea, Vol. 17, No. 2(1994)

Sex Preference and Sex Ratio at Birth: the Case of Taiwan

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《ABSTRACT》

This sutdy is attempting to examine the possible determinants of the rise of the sex ratio at birth from 106 to 110 in past decade in Taiwan. The basic hypothesis for the sudden rise of the sex ratio at birth is due to a combination of prenatal sex determination and abortion. The reasoning for this hypothesis involves three types of considerations — motivation, norm, and access. The theory is evaluated by analyzing data from birth registration and a large and representative sample of Taiwanese wives of childbearing age.

The empirical data seem to support the theoretical preposition and the basic hypothesis that the rise of the sex ratio at birth in Taiwan is due to a combination of prenatal sex determination and abortion. There is striking evidence of son-preference in the rise of the sex ratio at birth in higher birth order. In 1990 the sex ratio was 119 for third births and 128 for fourth and fifth births compared to the expected 106. Also, the 1991 KAP data indicated that women who have only daughters but no any son are more likely to make prenatal sex screening and terminate

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their pregnancies in male live births at higher birth order. Obviously, genetic diagnosis through chorionic villus sampling which was available in recent years was misused for prenatal sex determination and sex selective abortion.

Ⅰ. Introduction

During 1960－1986, the sex ratio at birth in Taiwan had been quite stable at about 106－107, similar to those observed in countries having reasonably good statistics. However, this ratio at birth climbed to 108 in 1987 and further jumped to 110 in 1990. Such a sudden rise in the sex ratio stimulated anxiety about long－term socio－economic implications and the government is actively trying to find out its reasons and solutions.

It sounds unlikely that the rise in the sex ratio at birth in Taiwan is due to underregistration and underenumeration of females. As well recognized, Taiwan's birth registration system has been producing continuous and dynamic data on birth statistic with high accuracy, completeness, and reliability for Island as a whole, from which the sex ratio statistic was derived. On the other hand, it is also unlikely that excess female infant and child mortality before people report their births to the household registration office simply because infant mortality is relatively low and female survival rate is higher than that of males. Accordingly, the main hypothesis responsible for this sudden rise in the sex ratio at birth for Taiwan as a whole is due to prenatal sex determination and sex selective abortion. The reasoning for this hypothesis is stated in the following section.

Ⅱ. Theoretical Framework

The theory for the sudden rise in the sex ratio at birth in Taiwan involves three types of considerations － motivation, norm, and access. The motivation for prenatal sex examination and sex selective abortion is stemming from boy preference. Norm about family size refers to a probability of having a son. Access pertains to knowledge about and subjective considerations about appropriateness of new medical technologies regarding prenatal sex screening and abortion, and the costs in time and money resulting form availability of such services and supplies. In general, prenatal sex termination and sex selective abortion is function of the degree of motivation, family size preference, and extent of access.

In more specific, two factors affecting the motivation for prenatal sex determination and sex selective abortion are sex preference in desired family size (D) and actual fertility or number of children (C). For those who want at least a son, if the actual number of children are all girls (Cg) and close to the desired family size, the motivation for prenatal sex determination and selective sex abortion is therefore formulated. Such a motivation would be getting stronger if the actual number of girls are greater than the desired number of girls (Dg). The more excess of the actual number of girls over the desired

number of girls are, the stronger motivation would be.

Although motivation is a necessary condition for prenatal sex screening and selective sex abortion, it is not a sufficient condition. The prenatal sex screening with selective sex abortion imposes costs on those who want at least a son in two aspects. There are psychic costs about the displeasure associated with the idea or practice of prenatal sex examination and selective sex abortion, and market costs regarding the time and money necessary to learn about and use specific techniques. These costs, in turn, depend on the availability of information and specific techniques and their prices about prenatal sex examination and selective sex abortion. Typically, a genetic health program for prenatal genetic diagnosis lowers market costs by increasing information and provides services with subsidy from government.

Whether prenatal sex screening and abortion for a female foetus will actually be used in a given balance or excess supply of female children (Cg ij Dg) depends on how the costs of the medical services compare with the motivation to get a son. Given the strength of the motivation, the lower the costs of prenatal sex screening and sex selective abortion, the greater would be the adoption of these medical services. Conversely,, the higher the costs of these medical services, the more nearly would actual conditions without prenatal sex determination and sex selective abortion.

Following this model, fecund women who have the preference for sons, but are unable to get any boy, can be grouped on the basis of demand of children with family composition preferences, and number of surviving girls, as the typology below shows:

1. $Cg < Dg < D$ or $(Db + Dg)$
   Deficit fertility

2. $Cg = Dg < D$ or $(Db + Dg)$
   Actual girls = Desired girls < Desired fertility

3. $D > Cg > Dg$
   Excess girls but still less than desired fertility

4. $D = Cg > Dg$
   Excess girls and actual girls equal to desired fertility

5. $Cg > D > Dg$ Excess fertility and girls

Where: D refers to desired family size Db refers to desired number of sons Dg refers to desired number of daughters Cg refers to number of daughters surviving

There are several cases needed to be noted here. One of these is a couple in a "deficit fertility" situation, that is, they have not produced as many children they want. Theoretically, it may be due to a shorter duration of marriage which is unable for the fecund women to produce their desired family size or they may be spacers or they may

have deficit fertility as a result of infant and child mortality. In this case, there is clearly no motivation to make the prenatal sex screening and sex selective abortion in order to get a son for these pregnant women.

In contrast to the above deficit fertility situation, a couple with a positive value of Cg $>$ D $>$ Dg or the excess family size but no son may try for a son, if they must have a son in the family. In this case, when they get pregnant and are aware of medical techniques and services for placental biopsy and abortion, they will ask for prenatal sex screening and sex selective abortion, if such a cost is lower than the disadvantages of an unwanted female child. Other things being equal, we may say that the larger the excess, the greater is a couple's motivation for prenatal sex screening and sex selective abortion.

Nevertheless, the desired family size or the demand of children is the number of surviving children a woman desires in a perfect or universal contraceptive society (Bumpass and Westoff, 1970). In such a perfect contraceptive society, we may say that a couple is not only able to achieve their desired family size, but also their desired sex composition through prenatal sex screening and sex selective abortion if the market and psychological costs associated with these medical techniques were negligible. In this case, women who achieve their desired number of daughters but have not got any son or Cg = Dg $<$ D (group 2) may ask for prenatal sex screening and make sex selective abortion if they were pregnant.

Based on these reasonings, it is likely that pregnant women will not make prenatal sex screening and sex selective abortion until they achieve their desired number of daughters but no any son. Consequently, prenatal sex screening and sex selective abortion would occur in higher birth order which is determined by the desired family size and family composition preferences. In other words, a couple with a larger desired family size may have prenatal screening and sex selective abortion in higher birth order than that of women with a smaller one, if they have strong boy preference but are unable to get a son.

If we assume that prenatal sex screening and sex selective abortion will occur among women with higher parity, the question is what proportion of women in a certain parity will make prenatal sex screening and sex selective abortion because of not getting a son, and the extent of its effect on sex ratio at birth for a given population. In general, it depends on desired family size.

The larger desired family size is, the lower probability of women without a son, and consequently, smaller proportion of women will try prenatal sex screening and sex selective abortion, and its effect on sex ratio at birth is also smaller. For example, if average desired number of children with preference for at least one son is five in a perfect contraceptive society where the market and psycho-

logical costs associated with prenatal sex screening and sex selective abortion is negligible, the probability of women with four daughters but no son is 1/16. This figure is obtained on the basis of the formula $(1/2 + 1/2)^4$ where the probability of getting a male or a female child in a given female population is assumed to be equal or 1/2. If all of the women with four daughters are making prenatal sex screening and sex selective abortion in their fifth pregnancy, the effect on sex ratio at birth will be only 1/16 during a certain period of time. However, if the average number of desired children with preference for at least a son is reduced to three children, the probability of getting two daughters but no son will increase to 1/4. If all of these women are making prenatal sex screening and sex selective abortion in their third pregnancy, the effect on sex ratio will be greater than do the women with four daughters in a given population. Therefore, other things being equal, it can be said that the effect of prenatal sex screening and sex selective abortion on sex ration will be greater for a population with a smaller desired family size than that of a population with a larger one.

Ⅲ. BACKGROUND AND MAJOR HYPOTHESES

Taiwan's net reproduction rate (NRR) fell to 1.0 in 1983, and has been below replacement level since 1984. In 1964, when the island-wide family planning program was promoted, the total fertility rate (TFR) was 5.10 and the net reproduction rate was 2.27. The sustained fertility decline began earlier. In 1955 the total fertility rate was 6.55 and the net reproduction rate was 2.82. Taiwan has completed the fertility aspect of the demographic transition during the 20 years after the intensive family planning program was implemented. In the meantime, Taiwan has almost reached a perfect contraceptive society or universal contraceptive use. By 1985 the proportion of women 35-39 who had ever practiced contraception reached 92 percent, with 86 percent currently practicing --close to saturation levels.

During the process of the fertility transition in Taiwan, traditional Chinese values as to emphasize large numbers of children and especially sons have been changing. The first island-wide Taiwan sample survey indicated that the preferred number of children for currently married women 22-39 was 4.0. This preferred family size* was maintained at 3.8 in 1970, but dropped significantly to 2.8 in 1980 and to 2.6 in 1985 (Chang, Freedman, and Sun, 1987). The latest KAP survey in 1991 further indicated that a small but consistent downward shift in average desired number of children took place from 2.6 in 1985 to

*In this paper the terms "desired," and "preferred" family size are used interchangeably. They all refer to the responses obtained in answer to the question, "If you were just getting married and could have just the number of children you want, how many would you like to have when when you are through having children?"

2.4 in 1991.

Along with the downward shift in the preferred number of children, there was a decrease in the preference for sons. Between 1965 and 1991, the proportion wanting only one son increased significantly, especially among younger women (52 percent of women aged 22–29 chose one son in 1991 compared with 49 percent in 1985 and 6 percent in 1965). There was a decrease in the proportion wanting two sons, from 72 percent in 1965 to 36 percent in 1985 and to 24 percent in 1991 (see Table 1).

Table 1. Percent Distribution of Preferred Number of Sons for Married Women Aged 22–39 by Wife's Age, Taiwan, 1965–91 (selected years)

Wife's Age and Surgvey Year	Percent Distrubition by Preferred Number of Sons						
	<2	2	3+	Either sons or daughters*	Indeterminate**	Total	Number of respondents
22–29							
1965	6	72	18	3	1	100	1,355
1970	7	77	11	4	1	100	1,107
1976	29	57	2	12	1	100	790
1980	35	55	1	9	–	100	1,764
1985	49	36	1	11	3	100	3,545
1991	52	24	0	22	0	100	1,693
30–39							
1965	4	61	32	2	1	100	1,694
1970	5	71	21	2	–	100	1,385
1976	19	65	5	10	1	100	895
1980	25	66	3	6	–	100	1,845
1985	35	49	2	10	5	100	4,792
1991	42	24	0	23	1	100	4,011

Note : Figures may not sum to 100 because of rounding. A dash indicates less than 1 percent.

* No Special preference; either Sex is alright.

** Answers "up to the gods," "up to fate," or not ascertained.

Source : Taiwan KAP Surveys.

Nevertheless, the continuing preference for sons was evident of the mean preferred numbers of sons and daughters in 1991:

Wife's age (years)	Mean preferred no.	
	Sons	Daughters
22–29	1.4	1.0
30–39	1.5	1.1

Distributions of family composition prefer-

ences are even more revealing than average (Table 2). In 1991, only 40 percent of the respondents expressed a preference for one son, but 64 percent were satisfied with one daughter. The modal preference in 1991 (40 percent) was for two children--- one son and one daughter --- a shift from the modal preference for two sons and one daughter in 1980. In 1965 only 4 percent had chosed one son and one daughter. In 1991 24 percent of the respondents still preferred two sons and one daughter, but this was down from 30 percent in 1985.

Significant behavioral evidence of the con-

Table 2. Percent Distrubution of Family Composition Preferences, Taiwan, 1965-91 (Selected years)

Preferred no. of children	Preferred no. of sons	Percent Distribution					
		1965	1970	1976	1980	1985	1991
2	1	4	5	23	28	37	40
3	2	23	30	40	41	30	24
4	2	40	41	20	17	11	7
4	3	6	5	1	1	0	0
5	3	13	8	1	0	0	0
6	3	4	0	0	0	0	0
Other combinations	–	6	8	3	3	8	7
Either sex alright	–	2	3	11	8	11	23
Indeterminate*	–	1	1	1	1	3	0
Total		100	100	100	100	100	100

Note : Figures may not sum to 100 because of rounding.

* Answers of "up to the gods," "up to fate," or not ascertained.

Source : Taoiwan KAP Surveys.

tinuing preference for sons in 1991 was that, among couples with similar numbers of children, desire for more children and practice of contraception were related to the number of sons they had (see Table 3), although differentials were smaller than in earlier years. For example, in 1991, among couples with two children, the proportion who wanted no additional children was 56 percent among those with no sons but 84 percent among those with no daughters. Similarly, among those with two children, the proportion practicing contraception was 76 percent among those with no sons but 90 percent among those with no daughters.

The son preference has been related with the excess of births over preferred number of children or excess fertility in Taiwan over time. Research by Chow (1983) indicated that factors affecting the excess fertility include contraceptive failures, son preference, sex composition, and child mortality perceptions, and these factors were negatively correlated with education. As such, it can be argued

Table 3. Percent of Married Women Aged 22–39 Who Want No Additional Children and Percent Who Are Currently Practicing Contrraeption by Number of Living Children and Living Sons, Taiwan, 1965–91 (Selected Years)

Number of Living Children and Living Sons	Percent wanting no additional children						Percent currently practicing contraception*						Number of respondents					
	1965	1970	1976	1980	1985	1991	1965	1970	1976	1980	1985	1991	1965	1970	1976	1980	1985	1991
0 children	6	6	0	3	0	3	0	6	8	16	20	27	127	73	73	166	292	333
1 child																		
0 sons	3	1	14	12	12	17	4	6	21	32	47	52	153	96	97	241	660	432
1 son	5	6	17	22	17	25	6	9	29	44	52	60	136	126	104	267	675	492
2 children																		
0 sons	9	5	50	39	50	56	11	20	48	54	73	76	128	93	52	152	471	412
1 son	19	31	67	73	80	85	12	29	53	68	81	88	252	244	184	423	1,301	1,172
2 sons	22	37	63	77	78	84	13	34	70	80	85	90	134	133	97	273	850	690
3 children																		
0 sons	14	12	46	60	82	71	9	10	49	58	80	81	70	56	35	71	208	164
1 son	29	51	87	88	85	94	17	40	65	74	88	93	185	179	145	338	884	61
2+ sons	69	79	99	98	94	98	31	55	83	84	92	95	337	356	317	712	1,523	850
4 children																		
0 sons	42	–	–	74	76	72	13	–	–	76	79	90	31	17	17	27	70	3
1 son	54	54	88	93	90	96	20	43	80	83	91	93	132	121	93	159	360	167
2+ sons	91	93	97	99	98	98	40	63	75	90	93	96	469	418	234	429	705	232
5+ children																		
0 sons	61	58	–	45	100	92	21	36	–	36	76	93	33	22	7	11	30	15
1 son	78	77	92	95	98	100	27	43	75	78	90	87	107	75	60	84	90	31
2+ sons	96	97	98	98	100	98	36	63	74	87	90	95	755	482	170	201	213	51
Total	57	61	74	73	71	71	24	44	63	70	78	81	3,049	2,491	1,685	3,554	8,332	5,689

Note : * Includes sterilization.

– Fewer than 20 cases in base.

Source : Taiwan KAP Surveys.

that under the universal contraceptive practice, the excess fertility will be reduced further as the use of prenatal sex determination and sex selective abortion is extended and results in decreasing the numbers of unwanted births. Whether the use of prenatal sex determination and sex selective abortion can be extended, it depends on psychic costs about the displeasure associated with the idea or practice of a combination of prenatal sex determination and abortion, and market costs regarding the time and money necessary to learn about and use specific techniques.

Prenatal sex screening can be made through either chorionic villus sampling (CVS) or amniocentesis, and these two techniques are available recently in Taiwan, though they have been evolved for many years (Bruno, 1992; Sherman and Simpson, 1992). Formally, the techniques are used for the prenatal diagnosis of genetic disorders. However, time of CVS somewhat differs with that of amniocentesis. The generally accepted lowest limit of gestational age for CVS is between 8 and 9 weeks, and amniocentesis has been traditionally performed at about the 15 and 16 weeks of gestation (menstrual weeks). Therefore, women who intend to perform a combination of prenatal sex determination and abortion usually choose CVS for sex screening simply because lower risk of induced abortion.

Based on the above background information, it can be hypothesized that women who have strong son preferences but are unable to get a son would be more likely to perform CVS for prenatal sex screening if they are aware of this technique and psychic costs about the displeasure associated with the idea or practice of a combination of prenatal sex determination and abortion, market costs regarding the time and money necessary to learn about and use the technique are low as well. If this is a case, women who perform CVS would be attributive to those with higher parity.

Ⅲ. THE DATA

The data regarding the trends in family size preferences and practice of family planning described in the previous section were derived from six island-wide interview surveys made in Taiwan in 1965, 1970, 1976, 1980, 1986, and 1992. The latter survey was conducted by the Taiwan Provincial Institute of Family Planning, the successor organization to the Taiwan Population Studies Center, which initiated the first study. Each of the six survey was based on probability samples chosen to represent all married women in the childbearing years in Taiwan, except for the few township (30 out of 361) in which most of Taiwan's small aborigine population lives. Since the six surveys are strictly comparable only for women in the age groups 22-39, the previous analysis was restricted to this age range.

The following analysis is based on two types of data: Taiwan's birth registration and 1992 KAP survey just mentioned. The former data concerning the sex ratio at birth by birth order and age of mother for Taiwan in 1987 and 1990 were kindly provided by the Ministry of Interior at my request. The latter data are needed to note further because the survey included a question regarding prenatal sex screening through CVS for each woman's recent pregnancies which ended in live births, stillbirths, or miscarries.

The universe of the sample for the 1992 KAP survey is comprised of about 2,871,602 currently married women (as shown in statistical data from household registration in January 1, 1992) in ages 20-44, living with their husbands in the non-aboriginal areas

of Taiwan. The survey was based on a probability sample of 12,987 currently married women 20－44 selected independently from each county/city in Taiwan. In more specific, the sample was designed to represent all eligible women in each county/city. However, to avoid a too large sample size for a larger city/city and a too small one for a smaller county/city, the sample size for each area was not allocated by the probability proportional to size. Instead, the counties and cities were grouped into five categories on the basis of its marital population size and assigned lower sampling fractions for larger counties or cities, and higher ones for smaller ones. The actual selection of respondents was made through three－ stage cluster sample in each county or county. As such, the overall sample is needed to weighted to represent all eligible women in Taiwan. The field survey was operated during March and April 1992. Of the total sample size, 11,789 or 91 percent were successfully interviewed.

Information obtained during the interview covered each woman's fertility and contraceptive status, her desired and expected number of children, and her attitudes toward and knowledge of family planning. In addition, information about prenatal sex screening through CVB for pregnancies occurring from 1987 to the date of interview and ended in live births, stillbirths or miscarries, measures of cioeconomic status, breastfeeding, and genetic knowledge were included.

Most of variables used in the following analysis are self－explained, or defined previously. However, IN and IS scale or Coombs scales are needed to note here. The Coombs scales have been well tested and are described in detail elsewhere (Coombs 1979a, 1979b: Coombs, Coombs, and Mcclelland 1975). The number scale (IN) measures the number of children desired with the usual single desired number statement as only one element in a continuum of an underlying preference distribution. Similarly, the sex preference scale (IS) measures the underlying tendency to prefer males, females, or a balance of the two. Both measures have been found to predict reproductive behavior, net of the effect of first preference statements and other demographic controls, on a cross－section basis in many countries and, more important, in longitudinal studies in Taiwan and the United States.

Ⅳ. FINDINGS

Up to 1986. birth statistics for Taiwan as whole indicate a moderate but consistent excess of boy babies over girl babies at birth. For the period 1960－1986, the average annual sex ratio of recorded births was 106.7 (Table 4). The series has a standard deviation of only 0.3 and the difference in the sex ratio between the observed and the mean value is only 0.2 or less for many years. Clearly, the sex ratio during this period had been quite stable. However, the sex ratio at birth increased from 107.3 in 1986 to 108.3 in 1987 and further jumped to 110.2 in 1990.

Table4. Sex Ratio at Birth for Taiwan Area, 1960－1990

Year	Male(1)	Female(2)	Sex Ratio at Birth (1)/(2) x 100
1960	216,354	203,088	106.5
1961	216,728	203,526	106.4
1962	218,332	205,137	106.4
1963	218,523	205,727	106.2
1964	215,119	201,807	106.5
1965	209,054	197,550	105.8
1966	213,327	201,781	105.7
1967	193,697	180,585	107.2
1968	203,642	190,618	106.8
1969	201,606	189,122	106.6
1970	203,168	190,847	106.4
1971	195,938	184,486	106.2
1972	188,132	177,617	105.9
1973	189,565	177,377	106.8
1974	183,850	172,083	106.8
1975	185,012	174,460	106.0
1976	218,659	205,416	106.4
1977	202,933	190,700	106.4
1978	213,155	198,482	107.3
1979	218,163	203,557	107.1
1980	212,399	119,494	106.4
1981	214,321	200,187	107.3
1982	207,663	194,242	106.9
1983	196,712	184,317	106.7
1984	190,976	177,836	107.3
1985	177,006	165,953	106.6
1986	158,554	147,774	107.2
1987	162,935	150,347	108.3
1988	177,856	164,371	108.2
1989	162,952	150,032	108.6
1990	176,378	159,928	110.2
Mean(1960－1986)			106.7
Standard Deviation			0.3

Source : Taiwan Demographic Fact Book, published by the Ministry of Interior.

s To examine possible reasons responsible for the sudden rise in the sex ratio at birth, the ideal approach is to compare data of stable value with that of increasing one by demographic characteristics of mothers. Unfortunately, data on the sex ratio at birth by age of mother and birth order are only available at hand during 1987—1990. Therefore, we should keep in mind that the sex ratio at birth in 1987 had already increased, when we look at related figures in that year.

Table 5 displays the sex ratio at birth by birth order and age of mother for Taiwan in 1987 and 1990. Such birth statistics clearly indicate that the sex ratio at birth tends to increase with successive births. In 1987, the sex ratio at birth for the first births was 107 which increased to 108 for the second births, and further rose to 110 and 114 for the third and the fourth births respectively. The sex ratio at birth for either the third births and above or the fourth births and above was similar to that of the third births or the fourth births, reflecting a negligible effect from the fifth births and above. This was mainly due to a small proportion of births attributive to the fifth births and above, which accounted only 1 percent in 1987. In 1990, the sex ratio at birth for the first and the second births was similar to those observed in 1987, but increased more significantly for the successive births. For example, the sex ratio at birth for the fourth births was 128 in 1990 compared with 114 in 1987.

Since the parity is positively associated with the increasing age of mother, the sex ratio at birth increases as the mother's age advances. The sex ratio at birth was significantly higher for married women aged 30 or above and tent to increase with age either in 1987 or 1990 (Last column of Table 5). For both years, the sex ratio at birth was below 110 for those under 30 years of age, but above 110 for those aged 30 or above in 1987 and 1990. Also, at a given older age group, the sex ratio at birth was higher in 1990 than that of 1987. For example, for two age groups 30— 34 and 35—39, the sex ratio at birth was 111 and 113 in 1987 against 117 and 120 in 1990. Further more, the sex ratio for older married women increased greater than that for younger women. This can be seen from changes in the sex ratios of births by parity among different age groups.

Another way to show that the age effect on the sex ratio at birth is to control the parity, and compare the sex ratios at birth among different age groups. As shown in Table 5, the sex ratio for the third births or the fourth births was higher for older married women than those for younger ones, and more significant in 1990. Clearly, older women have higher sex ratios at birth even if the parity is controlled.

On the other hand, the sex ratio at birth is also related with degree of urbanization. As shown in Table 6, the sex ratio at the third births or the fourth births in 1990 was highest for Taipei City and tent to decrease with lesser degree of urbanization: Kaohsiung

Table 5. Sex Ratio at Birth* by Birth Order and Age of Mother for Taiwan Area, 1987 and 1990

Parity Age	1	2	3	4	3+	4+	Total
			1987				
−20	108	116	91	42	87	54	109
20−24	107	108	109	108	109	106	108
25−29	107	108	109	109	108	107	108
30−34	108	109	114	11	116	119	111
25−39	105	109	116	119	118	119	113
40−44	120	130	114	156	107	105	113
45+	186	129	133	67	96	90	119
Total	107	108	110	114	111	113	108
			1990				
−20	108	105	117	57	113	57	108
20−24	105	108	115	110	114	110	107
25−29	107	108	117	120	117	120	109
30−34	111	112	121	135	125	135	117
35−39	105	109	132	147	135	140	120
40−44	118	113	136	134	128	124	122
45+	108	117	175	100	147	136	138
Total	107	109	119	128	121	128	110

* : Sex Ratio at Birth = $\frac{\text{Male}}{\text{Female}} \times 100$

Source : Taiwan's birth registration data tabulated by the Ministry of Interior.

City, other cities, and all counties in order. Nevertheless, with the exception of Taipei City, the overall sex ratio at birth for Kaohsiung City and all other cities was slightly lower than that of all counties (see the last column of Table 6). Such a discrepancy was due to higher concentration of the first births and the second births in urban areas than those in rural areas. In other words, the proportion of births occurring in 1990 was lower at the third births or the fourths in Kaohsiung City than those in provincial cities or counties. If we use the distribution of live births by birth order for Taipei as a standard population, the standardized sex ratio at birth is 112 for Taipei City, followed by 110 for Kaohsiung City, and 109 for provincial cities or counties in order. Clearly, the sex ratio at birth for the third births and the fourth is positively associated with degree of urbanization in Taiwan.

The above statistical evidence seems to sup-

Table 6. Sex Ratio at Birth* by Birth order, Age of Mother and Type of Administrative District for Taiwan Area, 1990

Age	Parity						
	1	2	3	4	3+	4+	Total
				Taipei City			
−20	89	123	100	—	100	—	93
20−24	111	108	133	220	137	200	111
25−29	106	110	119	100	116	101	109
30−34	112	109	142	160	145	161	117
35−39	104	116	153	221	167	214	128
40−44	81	148	100	271	149	255	126
45+	200	100	100	—	167	—	150
Total	108	110	134	156	138	159	112
#Birth	18,711	15,265	4,718	775	5,712	994	39,688
				Kaohsiung City			
−20	111	117	67	—	67	—	112
20−24	105	108	96	129	97	113	105
25−29	105	107	122	104	119	102	108
30−34	110	107	124	143	128	148	114
35−39	104	109	133	161	140	160	121
40−44	111	325	157	120	119	89	145
45+	0	—	—	—	—	—	100
Total	106	107	122	130	123	130	109
#Birth	9,231	7,871	2,879	490	3,462	583	20,564
				Provincial City as a Whole			
−20	107	82	114	—	114	—	103
20−24	104	108	107	90	104	82	105
25−29	105	105	116	132	118	126	107
30−34	112	117	121	143	125	143	119
35−39	103	101	141	130	133	121	116
40−44	75	104	125	29	77	52	86
45+	100	0	—	—	—	—	150
Total	105	108	119	131	121	128	109
#Birth	16,766	13,965	5,883	1,206	7,508	1,517	38,239
				Counties Total			
−20	110	106	120	57	115	57	109
20−24	105	109	115	110	115	111	107
25−29	108	108	116	121	117	120	110
30−34	111	113	117	132	121	132	116
35−39	105	107	123	139	128	133	117
40−44	149	85	157	156	136	128	128
45+	114	233	400	100	125	100	136
Total	107	109	117	121	119	126	110
#Birth	99,423	84,089	41,528	9,652	54,303	12,883	237,815

* : Sex Ratio at Birth $= \frac{\text{Male}}{\text{Female}} \times 100$

Source : Tiawan's birth registration data tabulated by the Ministry of Interior.

port the basic hypothesis of this study ——the sudden rise in the sex ratio at birth in 1990 in Taiwan was due to a combination of prenatal sex determination and abortion. In more specific, judging from the extremely higher sex ratios of births at the third births or the fourth births in 1990, we may say that some of women at their third pregnancies or fourth pregnancies or above did make prenatal sex screening and selective abortion. In other words, pregnant women who expected to have sons at their third or fourth pregnancies were more likely to keep male foetuses if the result of prenatal screening is male, but performed induced abortion if female. By this manipulation, the sex ratio at birth was therefore increasing.

Now, we turn to examine any direct evidence from our survey data. As indicated previously, information obtained in the 1992 Taiwan KAP survey covered each woman's fertility and contraceptive status, her desired and expected number of children, and prenatal sex screening for births, stillbirths, or miscarries occurring from 1987 to the date of interview, etc. We will use these data for further analysis.

Out of all respondents or 11,789 married women 20—44 in Taiwan in 1992, 83 women reported that they performed prenatal sex screening through CVS for pregnancies which ended in live births, miscarries, or stillbirths between 1987 to the date of interview (March or April 1992). In order to represent the situation for Taiwan as a whole, the 11,789 respondents were weighted and reduced to 5,704. As this result, the 83 cases with prenatal sex determination are therefore decreased to 56 cases after weighting. The percent distribution by year of occurrence is shown as follows:

Year	Non—weighted (%)	Weighted (%)
1987	9.6	9.6
1988	15.7	17.9
1989	13.3	12.7
1990	27.7	24.7
1991	22.9	22.6
January—March or April 1992	10.8	12.6
Total %	10.0	100.0
N	83	56

As expected, most of those pregnancies with prenatal sex determination through CVS turned out to be male live births, as data below show:

Outcome of pregnancy	Non—weighted (%)	Weighted (%)
Male live birth	72.0	71.4
Female live birth	24.4	24.0
Miscarry	1.2	0.9
Stillbirth	2.4	3.7
Total %	100.0	100.0
N	83	56

Obviously, those women who have made prenatal sex screening are more likely to terminate their pregnancies in male live births.

The above results seem to suggest that

many of those women with prenatal sex screening through CVS might expect to have sons. In fact, these women have strong son preferences, but were unable to achieve their desired sons (Table 7). For example, prior to performing prenatal sex screening through CVS, average number of living children owned by those women were 2.1, but out of these children, only 0.3 were sons. Furthermore, average number of desired children and sons for those women are 2.4 and 1.3 respectively. Obviously, there is excess girls in the overall situation, and can be expressed in terms of the theoretical framework sketched above, that is D (2.4) > Cg(1.8) > Dg(1.1). In contrast to this situation, there is a deficit son situation, that is, that they are unable to produce as many sons as they want. The average number of sons desired were 1.3 against only 0.3 they had before they performed prenatal sex screening through CVS. In addition, these women have very strong preference for sons, as measured by IS scale (Table 7). Such evidence strongly suggested that motivation for prenatal sex screening stemmed from preference for sons.

Table 7. Fertility Measures for Married Women Aged 20—44 Who Performed Prenatal Sex Determination through CVS for Live Births, Stillbirths, and Miscarries Occurring since 1987, Taiwan, 1992

Fertility Measures	Mean
Desired number of children	2.4
Desired number of sons	1.3
Number of living children prior to prenatal sex Determination through CVS	2.1
Number of living sons prior to prenatal sex determination through CVS	0.3
IN scale(1—7)	2.4
IS scale(1—7)	5.1
N(weighted sample)	56

V. SUMMARY AND DISCUSSION

This study is attempting to examine the possible determinants of the rise of the sex ratio at birth from 106 to 110 in past decade in Taiwan. The basic hypothesis for the sudden rise of the sex ratio at birth was due to a combination of prenatal sex determination and abortion. The reasoning for this hypothesis involves three types of considerations — motivation, norm, and access. The theory is evaluated by analyzing data from birth registration and a large and representative sample of Taiwanese wives of childbearing age.

The empirical data seem to support the theoretical preposition and the basic hypothesis that the rise of the prenatal sex

determination and abortion. There is striking evidence of son-preference in the rise of the sex ratio at birth in higher birth order. In 1990 the sex ratio was 119 for third births and 128 for fourth births and above, compared to the expected 106. The latest birth statistics continued to show that the sex ratio at birth in 1991 stayed at the same level and pattern as observed in 1990. Also, the 1992 KAP data indicated that women who had only daughters but no any son were more likely to perform prenatal sex screening and terminated their pregnancies in male live births at higher birth order. Obviously, genetic diagnosis through chorionic villus sampling (CVS) which was available in recent years was misused for prenatal sex determination and sex selective abortion.

Whether the future sex ratio at birth will change seems to depend on changes in desired family size, son preferences, and access to CVS or other medical techniques for prenatal sex determination. As suggested in this study, the declines in desired family size together with more aware and availability of CVS would be favorable to the rise in the sex ratio at birth as continuing son preferences persist. However, the diffusion of knowledge about complications of prenatal sex screening through CVS such as preterm births, small-for-dates neonates, low birth weight, and disabled newborns caused by improper medical techniques of CVS may increase the displeasure associated with the idea or practice of prenatal sex screening, and thus wash out some of the favorable effects. Also, continuing decline in son preference and effective government policies to prevent prenatal sex determination through CVS will have negative impact on the increase in the sex ratio at birth in Taiwan.

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