On Regional Variation of Sex Preference in China *

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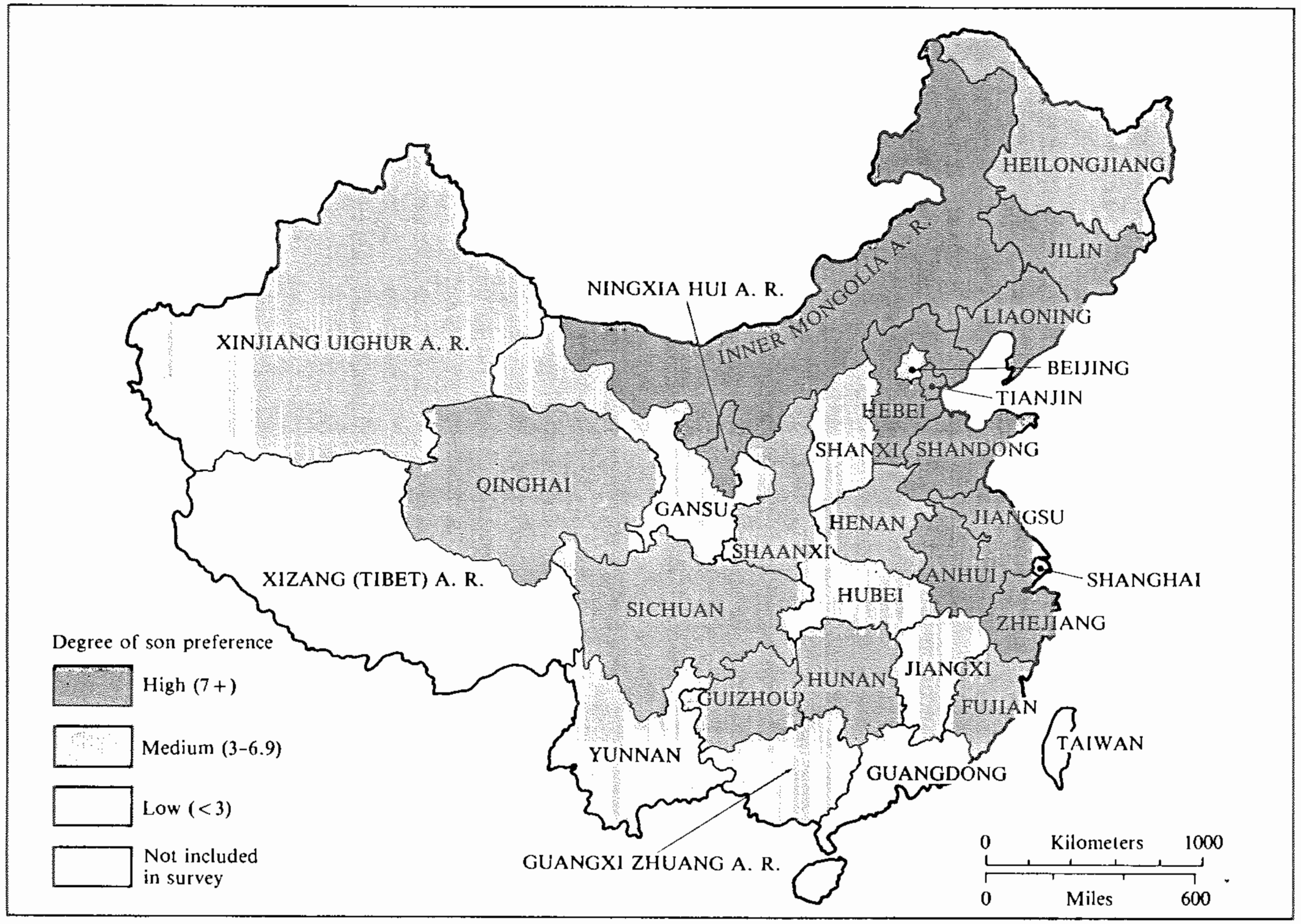
Son preference is, to a large extent, a universal phenomenon (Williams, 1976; Bennett, 1983; Cleland, Verrall, and Vaessen, 1983). It is especially strong and pervasive in East Asia, where one observes a cultural linkage between China and her neighboring countries. It has been proposed that the root of son preference in East Asia is Confucian traditions. Extensive research in support of this hypothesis has been carried out in places like Korea and Taiwan (Cho, Arnold, and Kwon, 1982; Freedman and Coombs, 1974; Coombs and Sun, 1981). Recently, Arnold and Liu provided empirical evidence for the first time on sex preference in mainland China (1986).

Arnold and Liu showed, convincingly, that sex preference is still strong in today's mainland China despite the efforts of the Chinese Communist Party to promote sexual equality over the past few decades. They also found that the degree of sex preference varies with region, education, place of residence, and nationality. While it is understandable that education and urban residency, as aspects of modernization, would reduce sex preference, we should not accept the variation of sex preference among regions and nationality groups too quickly. As we will show in this paper, the degree of sex preference in China is regionally homogenous, and the regional variation observed by Arnold and Liu is due to floor and ceiling effects and sampling variability.

Evidence of Regional Variation of Sex Preference in China

Figure 1 was presented by Arnold and Liu as their finding of the regional

FIGURE 1 Degree of son preference by province, measured by receipt of one-child certificates in 1982



SOURCE: Table 1, column 7. Copied from Arnold and Liu (1986, p.230).

variation of sex preference in China. According to the figure, there is generally more preference for males in the eastern part of the country than in the remote hinterland. This conclusion is puzzling because the eastern part of China is not only more densely settled, but also more industrialized, and more developed than other parts of China. Since it is believed that modernization should reduce sex preference (Williams, 1976; Bennett, 1983), one wonders why the pattern of regional variation of sex preference in China is not as expected. To solve the puzzle, we need to start with the measurement of sex preference.

Over the past decade, criticisms of measures of sex preference have been raised and new measures proposed as a result (Coombs, Coombs, and McClelland, 1975; Arnold, 1985). In the case of China, however, these new techniques cannot be applied due to limitations of data. Arnold and Liu, who had access to the One-Per-Thousand National Sample Fertility Survey conducted in 1982, used behavioral measures. They paid special attention to couples with one child. This is justified because a one-child policy has been in effect in China for several years. Since all behavioral measures have certain problems (McClelland, 1983), Arnold and Liu's measures are inherently weak. The proper question is whether some of Arnold and Liu's conclusions hold, and whether we can do any better with these data on behaviors of couples with one child. We should have a closer look at the measures used by Arnold and Liu.

In Figure 1, Arnold and Liu used the difference in percentages of acceptance of one-child certificates between couples with one boy and couples with one girl. One-child certificates are given to couples who pledge not to have a second child under penalty, and who then in return receive certain monetary and other rewards. Table 1 gives respective percentages and the total counts on which the percentages are based.

From now on, we will call this measure AL1.

Similarly, Arnold and Liu defined two other measures of sex preference across regions. We will call them AL2 and AL3. Table 2 and Table 3 give the data from which AL2 and AL3 were computed. AL2 and AL3 can be defined as follows:

> AL2 = difference in percent of one-child certificate recipients in 1982 who have renounced the certificate by having a second child, between one-girl couples and one-boy couples (Arnold and Liu, 1986, Table 3).
>
> AL3 = difference in percent of currently married one-child couples using contraception in 1982 between one-boy couples and one-girl couples (Arnold and Liu, 1986, Table 4).

One problem with AL1 through AL3 is that, as differences in percentages, these measures contain floor and ceiling effects. For example, according to AL1, sex preference is low in Qinghai (12.7 − 6.6 = 6.1) even though couples in that province with one boy are nearly twice as likely to receive a one-child certificate as couples with one girl. By the same token, AL1 seems to have overestimated sex preference in Jiangsu (63.6 − 52.7 = 10.9) and Shangdong (58.7 − 48.1 = 10.6), because in these two provinces the overall percentages of receiving the certificates among one-child couples are near 50%. One way to correct the floor and ceiling effects is to take log-odds-ratios. We define LOR1 as:

$$LOR1 = log\left(\frac{P(C|1boy)/P(NC|1boy)}{P(C|1girl)/P(NC|1girl)}\right)$$

where $P(C|*)$ is the conditional probability of receiving a one-child certificate and $P(NC|*)$ is the conditional probability of not receiving the certificate. We use percentages in Table 1 as estimates of probabilities and calculate LOR1. Likewise, we define LOR3 in correspondence to AL3. Since Table 2 contains several zero cells, we

TABLE 1: Percent and Base of One-Child Couples in 1982 Who Have Received a One-Child Certificate by Province.

	Sex of Child						
	Girl		Boy		Total		AL1
	%	counts	%	counts	%	counts	(3)-(1)
Province	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Beijing	76.4	250	74.6	280	75.5	530	-1.8
Tianjin	78.6	206	86.2	224	82.6	430	7.5
Hebei	30.1	1040	37.5	1237	34.1	2277	7.4
Shanxi	15.3	426	16.8	481	16.1	907	1.6
Inner Mongolia	31.6	370	41.5	398	36.7	768	9.8
Liaoning	66.1	866	74.6	1093	70.8	1959	8.5
Jilin	32.5	351	46.5	529	40.9	880	14.0
Heilongjiang	31.5	502	38.0	652	35.2	1154	6.6
Shanghai	77.3	419	78.8	454	78.1	873	1.5
Jiangsu	52.7	1439	63.6	2022	59.0	3461	10.9
Zhejiang	22.1	660	30.4	737	26.5	1397	8.3
Anhui	13.2	623	22.5	775	18.3	1398	9.3
Fujian	13.6	324	17.1	409	15.5	733	3.5
Jiangxi	6.8	367	7.1	534	7.0	901	0.3
Shandong	48.1	1317	58.7	1787	54.2	3104	10.6
Henan	18.1	915	22.4	1243	20.6	2158	4.3
Hubei	39.6	923	41.2	1087	40.5	2010	1.6
Hunan	14.3	791	19.8	972	17.3	1763	5.5
Guangdong	13.5	784	12.2	937	12.8	1721	-1.3
Guangxi	9.7	453	10.9	488	10.3	941	1.2
Sichuan	47.3	1799	54.0	2172	50.9	3971	6.7
Guizhou	9.3	323	13.9	375	11.7	698	4.6
Yunnan	14.8	480	17.4	564	16.2	1044	2.6
Shaanxi	30.5	417	37.3	574	34.4	991	6.8
Gansu	15.7	274	17.7	311	16.7	585	2.0
Qinghai	6.6	76	12.7	79	9.7	155	6.1
Ningxia	25.0	72	33.3	75	29.3	147	8.3
Xinjiang	10.6	217	11.9	253	11.3	470	1.3

Source: Columns (1), (3), (5), and (7) are from Arnold and Liu (1986, Table 1);
columns (2), (4), and (6) are kindly provided by Fred Arnold.

TABLE 2: Percent and Base of One-Child Certificate Recipicients in 1982 Who Have Renounced the Certificate by Having a Second Child

	Sex of Child						
	Girl		Boy		Total		AL2
	%	counts	%	counts	%	counts	(1)-(3)
Province	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Beijing	0.9	113	0.0	145	0.4	258	0.9
Tianjin	1.0	95	1.6	123	1.4	218	-0.6
Hebei	27.3	289	15.7	381	20.7	670	11.6
Shanxi	44.9	49	25.4	59	34.3	108	19.5
Inner Mongolia	8.6	70	3.1	96	5.4	166	5.5
Liaoning	10.3	407	4.7	594	7.0	1001	5.6
Jilin	1.3	74	0.0	160	0.4	234	1.3
Heilongjiang	3.5	87	0.0	146	1.3	233	3.5
Shanghai	1.8	219	0.0	243	0.9	462	1.8
Jiangsu	6.4	518	2.6	942	3.9	1460	3.8
Zhejiang	1.0	96	0.0	154	0.4	250	1.0
Fujian	34.1	41	17.5	57	24.5	98	16.6
Shandong	20.8	432	9.9	740	13.9	1172	11.0
Henan	10.5	86	5.7	157	7.4	243	4.8
Hubei	10.0	230	9.5	295	9.7	525	0.5
Hunan	32.1	106	14.1	156	21.4	262	18.0
Guangdong	1.9	53	0.0	57	0.9	110	1.9
Sichuan	13.3	675	8.6	936	10.6	1611	4.7
Yunnan	6.5	46	3.2	62	4.6	108	3.3
Shaanxi	25.2	103	19.2	172	21.5	275	6.0
Other*	5.8	139	1.8	221	3.6	360	4.0

* Including Anhui, Jiangxi, Guangxi, Guizhu, Gansu, Qinghai, Ningxia, and Xinjiang.

Source: Columns (1), (3), (5), and (7) are from Arnold and Liu (1986, Table 3);
columns (2), (4), and (6) are kindly provided by Fred Arnold.

TABLE 3: Percent and Base of Current Married One-Child Couples Using Contraception in 1982 by Province.

	Sex of Child						
	Girl		Boy		Total		AL3
	%	counts	%	counts	%	counts	(3)-(1)
Province	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Beijing	94.1	238	91.5	259	92.8	497	-2.6
Tianjin	86.2	188	95.3	213	91.0	401	9.1
Hebei	73.5	952	79.3	1097	76.6	2049	5.8
Shanxi	56.5	361	63.9	404	60.4	765	7.4
Inner Mongolia	57.5	346	66.2	364	62.0	710	8.7
Liaoning	78.1	809	82.0	1027	80.3	1836	3.9
Jilin	85.7	335	92.9	510	90.1	845	7.2
Heilongjiang	69.6	463	76.8	607	73.6	1070	7.2
Shanghai	89.6	365	88.6	396	89.1	761	-1.0
Jiangsu	77.0	1313	84.2	1838	81.2	3151	7.2
Zhejiang	51.1	581	60.6	673	56.2	1254	9.5
Anhui	48.5	540	53.6	636	51.3	1176	5.1
Fujian	46.2	279	58.4	353	53.0	632	12.2
Jiangxi	26.2	302	33.2	422	30.3	724	7.0
Shandong	75.9	1197	83.0	1592	80.0	2789	7.1
Henan	74.1	789	74.8	1071	74.5	1860	0.7
Hubei	60.9	808	63.1	930	62.1	1738	2.2
Hunan	47.4	690	55.9	834	52.0	1524	8.5
Guangdong	35.8	701	41.4	753	38.7	1454	5.6
Guangxi	26.3	396	31.1	405	28.7	801	4.8
Sichuan	75.3	1606	76.8	1920	76.1	3526	1.5
Guizhou	23.0	283	35.9	287	29.5	570	12.9
Yunnan	35.8	408	35.0	475	35.3	883	-0.8
Shaanxi	63.7	366	72.8	500	68.9	866	9.1
Gansu	50.9	236	58.0	257	54.6	493	7.1
Qinghai	25.4	59	33.3	54	29.2	113	7.9
Ningxia	52.4	63	56.9	72	54.8	135	4.5
Xinjiang	23.8	181	28.9	201	26.4	382	5.1

Note: This table is based on currently married women under 50 years old.

Source: Columns (1), (3), (5), and (7) are from Arnold and Liu (1986, Table 4); columns (2), (4), and (6) are kindly provided by Fred Arnold.

did not compute LOR2.

Another problem with AL measures is that they ignore the information contained in the marginal distribution of the sex of child at parity one. It is well known that sex ratio of lastborn can be used as a behavioral measure of sex preference (e.g., McClelland, p.28.). Arnold and Liu, in other parts of the same paper, examined at the national level sex ratio of child at parity one and correctly attributed the high sex ratio of child at parity one (125.0) to the prevailing son preference in China (1986, Table 7). This is because, under the same pressure from local authorities to have one child, couples with one girl are more likely to have a second birth than couples with one boy when they are compelled by their preference for sons over daughters. We can use sex ratio of child at parity one to study sex preference at the regional level. To do that, we compute SR from Table 1:

$$SR = \frac{\#boy}{\#girl}$$

where $\#boy$ stands for the number of only-boys (column 4 in Table 1), and $\#girl$ stands for the number of only-girls (column 2 in Table 1). SR varies from 1.039 in Qinghai to 1.507 in Jilin. Because the sex ratio measure computed from Table 3 (data for AL3) is similar to that from Table 1, there is no need to have another measure of sex ratio of child at parity one. Table 4 presents a correlation matrix of three AL measures, two LOR measures, one SR measure, and some variables indicating socioeconomic development at regional level.

Table 4 shows that the measures of sex preference based on difference in percentages suffer from several weaknesses. First, there is little correlation among all the three measures used by Arnold and Liu. The convergent validity of the measures

TABLE 4: Correlation Matrix of Measures of Sex Preference and Socioeconomic Variables across Regions

	AL1	AL2	AL3	LOR1	LOR3	SR	TFR	ILLI	CITY
AL1	1.000								
AL2	0.012	1.000							
AL3	0.357	0.341	1.000						
LOR1	0.851	0.027	0.469	1.000					
LOR3	0.521	0.061	0.797	0.579	1.000				
SR	0.333	0.084	0.127	0.092	0.210	1.000			
TFR	-0.240	0.049	0.169	0.029	-0.037	-0.312	1.000		
ILLI	0.163	0.029	0.195	0.342	-0.007	-0.012	0.519	1.000	
CITY	-0.117	-0.346	-0.305	-0.113	-0.012	-0.265	-0.545	-0.597	1.000
mean	5.275	5.454	5.818	0.297	0.306	1.212	2.690	0.229	0.151
st.dev	3.400	5.171	3.778	0.210	0.284	0.127	0.841	0.068	0.142

Note: (1) Except for AL2, all other measures and variables are based on 28 regions defined in Table 1. Since Arnold and Liu collapsed 8 regions with small counts into a single category in making AL2, we imputed the same score in this category to all the 8 regions in order to calculate correlations.
(2) TFR = total fertility rate in 1981. Source: Poston and Gu (1986, Figure 2).
(3) Illi = illiteracy rate (aged 12 and over). Source: State Statistical Bureau (1984, p.94).
(4) City = proportion of population living in cities. Source: State Statistical Bureau (1984, p.93).
(5) See text for explanation of AL1, AL2, AL3, LOR1, LOR3, SR.

is highly questionable (Borhnstedt, 1983). In this regard, the LOR measures seem to be better. Second, all three AL measures have low correlations with socioeconomic variables, and the correlation between AL1 and TFR is opposite in sign to what we expect. Since of the three AL measures AL1 received most of the attention in Arnold and Liu's discussion of regional variation of sex preference, we should have a more detailed discussion of AL1 in our re-analysis.

Measures and Sample Variability

LOR1 improves over AL1: it has a higher correlation with other measures, and it is nearly orthogonal to TFR. At the same time, the correlation between LOR1 and AL1 is 0.851, so it could be argued that AL1 catches most of the variation of LOR1 even if LOR1 is a better measure of sex preference. Can we readily accept LOR1 as the true measure of sex preference?

On the other hand, the SR measure has a negative correlation with the total fertility rate and the illiteracy rate, and low correlations with other measures of sex preference. SR is not a satisfactory measure even though, from our reasoning, SR should be a sensible measure of sex preference. If all the measures are purported to measure the same thing, why do they behave so inconsistently?

We know that these data are from a sample, albeit a high-quality sample (Yu and Xiao, 1984; Li, 1984). For sample data, we need to take sampling variability into account, and we should not treat samples as populations. A certain degree of sampling variability is allowed and even expected in any analysis of sample data. For example, we see in Table 1 that couples in Beijing and Guangdong prefer daughters to sons on both the AL1 and LOR1 measures. Should we conclude that there is daughter preference in Beijing and Guangdong? No, not unless we are given a very good reason. Since all our theories, experiences, and other data sources support the thesis that there is son preference in China as a whole, but not daughter preference, we should attribute the negative cases of Beijing and Guangdong to sampling variation unless the contrary evidence is overwhelming.[1]

In a similar way, we should not conclude regional variation of sex preference unless we have reason to disprove the hypothesis of homogeneity, which was implied in Coombs' observation that variations of sex preference within countries are much smaller than those between countries (1977). The lack of convergent validity of the different measures shown in Table 2 suggests that the regional variation of sex preference in China is not so great as to be measured easily. Why can we not retain the hypothesis of homogeneity of sex preference in China, if the evidence of heterogeneity is not so strong?

Nothing can be "truly" homogeneous across regions. What is at issue is whether the differences among regions are so great as to be theoretically interesting and statistically reliable. In the case of China, we know that there are considerable regional variations in socio-economic development, in population density, and in fertility rate (Poston and Gu, 1986). These variations draw our attention because they tell us that different parts of the country are at different levels of development and in different stages of demographic transition. They also have implications for policy-makers.

[1]In interpreting evidence of daughter preference in Beijing, Arnold and Liu gave two possible reasons: (1) "daughters are widely believed to be closer to the parents" and (2) "sons may be more expensive because the parents need to provide them with sufficient resources to find a suitable marriage partner" (Arnold and Liu, 1986, p.233).

Arnold and Liu were cautious in their interpretation of their finding of regional variation of sex preference. Their main purpose is to ascertain the existence of sex preference in China and the effect of sex preference on fertility and family planning. They suggest that the observed regional variation of their measures of sex preference could be partly due to "difference in the vigor with which local family planning officials have implemented the one-child policy" (Arnold and Liu, 1986, p.229). The regional variation of vigor with which local authorities implement the one-child policy is not necessarily associated with the variation of measures of sex preference. For example, the vigor of policy-implementation affects only the marginals, not the odds ratios. That is, the proportions of couples accepting one-child certificates for either one boy or one girl fluctuate according to the vigor with which the local authority implements the one-child policy. The vigor varies with region. But unless the sex bias of the vigor exercised locally varies regionally (that is, there is an interaction between vigor and sex over regions), which would be a result of regional variation of sex preference, the difference in vigor of executing the one-child policy at the local level should not affect our LOR measure of sex preference.

It is possible to argue that, as fertility rates go down with vigorous implementation of one-child policies, the average number of children per woman declines, and the effect of sex preference on sex ratio increases. That is, if many couples still want to have at least one boy when fertility declines, the sex ratio will increase. Thus the overall sex ratio would be affected by the vigor with which the one-child policy is carried out. However, our SR measure does not necessarily increase as a result because the analysis is limited to couples with only one child. A vigorous implementation of the one-child policy would only result in an increase in the proportion of couples with one child without necessarily altering the sex composition of only-children. Only when there is a selection bias of those who happened to have one child at the time of survey in a relatively high fertility region as compared to those who have one child under pressure (which is fairly plausible), could the vigor of implementing one-child policy affect sex ratio of child at parity one, i.e., the SR measure. Therefore, the extent of the effect of vigor with which local authorities implement the one-child policy on the SR measure is not very large.

A fruitful way to analyze the data is to use standard loglinear models (Bishop et al., 1975; Goodman, 1978, 1984). Loglinear models have already been applied in analysis of sex preference (Cleland, Verrall, and Vaessen, 1983). We can view each data set as consisting of twenty-eight 2×2 tables. From Table 1, for example, this can easily be done by categorizing the total count of one-child couples (column 6 in Table 1) in each region along two dimensions: sex of the child (boy vs. girl) and acceptance of a one-child certificate (yes vs. no). There are twenty-eight odds-ratios for the saturated model. We can constrain all the odds ratios to be equal and have a test with twenty-seven degrees of freedom testing homogeneity of odds ratio. Likewise, we can test homogeneity of sex ratios through constraints on marginals. The goodness of fit statistics of relevant models are shown in Table 5.

In Table 5, there are two models for the hypothesis of homogeneous sex preference in China: Model (3) and Model (4). Model (4) tests the homogeneity of odds-ratios, while Model (3) tests homogeneity not only of odds ratios but also of margin of sex. In other words, Model (3) says not only that the odds-ratios of accepting a one-child certificate are the same across regions, but that the sex ratio of child at parity one is the same across regions. By formal log-likelihood ratio test,

TABLE 5: Loglinear Models of Sex Preference Data in Table 1

Model	Descrition	L-2	D.F.	BIC
(1)	Sex+Cert+Region	7299	82	6436
(2)	(1)+Region*Cert	296.2	55	-283.0
(3)	(2)+Cert*Sex	136.7	54	-431.9
(4)	(3)+Region*Sex	47.3	27	-237.3
sample size = 37426				

Note: Sex = Sex of child of one-child couples, boy vs. girl.
Cert = Acceptance of one-child certificates, yes vs. no.
Region = Provinces and regions, 28 categories.
L-2 = log-likelihood ratio statistic, Glim output.
D.F. = Degrees of freedom.

we would accept Model (4) over Model (3) (χ^2 being 89.4 for 27 degrees of freedom) but fail to reject Model (4) only at the significance level of 0.005 (χ^2 being 47.3 with 27 degrees of freedom).[2] However, the model of homogeneity is much more powerful than the log-likelihood ratio test suggests if we consider the large size of the sample in this $2 \times 2 \times 28$ cross-classified table (37426). We know that, with large samples, the log-likelihood ratio test is likely to reject a good model. Raftery proposed the BIC statistic for large samples: BIC= $L^2 - (df)logN$, where L^2 is log-likelihood ratio statistic, *df* is the associated degrees of freedom, and N is sample size (Raftery, 1986). If BIC is negative, we should accept the null hypothesis. When comparing several models we should select the model with the lowest BIC value. Applying BIC to models in Table 3, we find that Model (3) should be selected as a satisfactory model. Therefore, the hypothesis of homogeneity of sex preference in China is retained. This conclusion holds at two levels: the odds ratio of accepting one-child certificates and

[2]The log-likelihood ratio statistic L^2 is asymptotically distributed as χ^2 distribution. For nested models (3) and (4), $L_3^2 - L_4^2$ is asymptotically distributed as χ^2 distribution with $DF_3 - DF_4$ degrees of freedom. See Bishop et al. (1975).

TABLE 6: Loglinear Models of Sex Preference Data in Table 2

Model	Descrition	L-2	D.F.	BIC
(1)	Sex+Second+Region	772.3	61	211.6
(2)	(1)+Region*Second	177.8	41	-199.1
(3)	(2)+Second*Sex	82.0	40	-285.7
(4)	(3)+Region*Sex	25.1	20	-158.8
sample size = 9824				

Note: Sex = Sex of child of couples with one-child certificates, boy vs. girl.
Second = Renouncing certificate by having a second child, yes vs. no.
Region = Provinces and regions, 21 categories.
L-2 = log-likelihood ratio statistic, Glim output.
D.F. = Degrees of freedom.

the marginal distribution of sex at parity one.

Table 6 and Table 7 report the results of applying the same set of loglinear models to data in Table 2 and Table 3. Previously, these three sets of data did not give rise to a consistent measure of sex preference at regional levels. Comparing Table 5, Table 6, and Table 7, the patterns of fitness of the four models are amazingly similar. We can be confident that all three sets of data tell us the same story: there is overwhelming evidence of confirming Arnold and Liu's finding that sex preference is strong in today's China;[3] but the regional variation of sex preference is so small that we can treat it as a result of sampling variation. The attempt to measure the regional variation is premature because it is so contaminated by the sampling variation that the precision of measurement is seriously in question. Without other information and data sources, we are content with the conclusion that the level of sex preference

[3]Nesting models (2) and (3) in Table 5, Table 6, Table 7 respectively, we have a χ^2 test: for Table 5, $\chi^2 = 296.2 - 136.7 = 159.5$, for Table 6, $\chi^2 = 177.8 - 82.0 = 95.8$, for Table 7, $\chi^2 = 254.2 - 113.1 = 141.1$, each with 1 degree of freedom.

TABLE 7: Loglinear Models of Sex Preference Data in Table 3

Model	Descrition	L-2	D.F.	BIC
(1)	Sex+Contra+Region	4921	82	4068
(2)	(1)+Region*Contra	254.2	55	-318.0
(3)	(2)+Contra*Sex	113.1	54	-448.7
(4)	(3)+Region*Sex	53.1	27	-227.8
sample size = 33005				

Note: Sex = Sex of child of one-child couples, boy vs. girl.
Contra = Using contraception, yes vs. no.
Region = Provinces and regions, 21 categories.
L-2 = log-likelihood ratio statistic, Glim output.
D.F. = Degrees of freedom.

in China is about the same.

Variations of Sex Preference Along Other Dimensions

Arnold and Liu found variations of sex preference along dimensions of nationality, place of residence, and education. Nationality is an important dimension because, in explaining regional variation of sex preference, Arnold and Liu resort to it: "Several of the areas with low levels of son preference have large minority populations that exhibit different sex preferences for children than the Han majority" (Arnold and Liu, 1986, p.229). Since minorities are predominant in several regions, variation of sex preference among nationalities means variation across regions.

Table 8, corresponding to Table 1, presents percentages and counts of one-child couples who have received a one-child certificate by nationality, place of residence, and educational attainment. Again Arnold and Liu used differences in percentages of accepting one-child certificates among one-child couples as measures of sex preference. We denote these measures as NAT1, PLA1, and EDU1, shown in Table 8. It is

TABLE 8: Percent and Counts of One-Child Couples in 1982 Who Have Received a One-Child Certificate by Characteristics

Characteristic of wife	Girl % (1)	Girl counts (2)	Boy % (3)	Boy counts (4)	Total % (5)	Total counts (6)	(3)-(1) (7)
Nationality							NAT1
Han	35.7	15655	42.1	19529	39.2	35184	6.4
Zhuang	4.2	216	5.8	242	5.0	458	1.6
Hui	25.3	99	27.8	144	26.7	243	2.5
Wei	2.0	149	2.3	173	2.2	322	0.3
Yi	7.1	42	1.4	70	3.6	112	-5.7
Miao	1.4	72	2.7	73	2.1	145	1.3
Manchu	31.5	73	44.8	125	39.9	198	13.3
Tibetan	1.0	104	0.0	95	0.5	199	-1.0
Mongolian	15.7	51	17.7	51	16.7	102	2.0
Other minority	3.6	223	6.3	240	5.0	463	2.7
Place of Residence							PLA1
City	74.8	3279	76.7	3759	75.9	7038	1.9
Town	43.0	721	53.1	910	48.6	1631	10.1
Rural nonfarm village	38.3	214	44.8	252	41.9	466	6.5
Rural Farm village	22.6	12470	30.8	15821	27.2	28291	8.2
Educational Attainment							EDU1
Illiterate	15.5	6332	22.2	8203	19.3	14535	6.7
Elementary school	31.5	4484	41.6	5651	37.2	10135	10.1
Junior high school	56.1	4102	61.9	4828	59.3	8930	5.8
Senior high school	53.1	1607	56.6	1902	55.0	3509	3.5
University	73.4	158	76.6	158	75.0	316	3.2

Source: Columns (1), (3), (5), and (7) are from Arnold and Liu (1986, Table 2);
columns (2), (4), and (6) are kindly provided by Fred Arnold.

clear by now that these measures are subject to the same criticisms that we raised against AL1. With that in mind, one should not be surprised to see that under PLA1 measure, there is greater sex preference in towns than in either rural nonfarm villages or rural farm villages. Neither should one be surprised to note that couples with wives who have completed elementary education are more sex preferential than couples with illiterate wives. We will not construct alternative measures to correct problems in measures NAT1, PLA1, and EDU1. Since our main interest is the hypothesis of regional homogeneity, we will discuss the nationality, place of residence, and education separately in relation to that hypothesis.

(1) NATIONALITY

There are 85 nationalities in addition to the majority Han listed in Census tabulations (Population Census Office, 1985). They are mostly distributed in western, remote areas. Five Autonomous Regions (administrative units similar to provinces for areas with heavy minority populations) are named after minorities: Inner Mongolia A.R., Guangxi Zhuang A.R., Ningxia Hui A.R., Tibet A.R. and Xingjiang Uighur A.R.. Concentrated in vast areas of these Autonomous Regions and their neighboring provinces is a minority population of sixty-seven million, six percent of the total population (Population Census Office, 1985). It has been shown that minorities in general have lower age at marriage and a higher fertility rate (Shen and Ma, 1984; Qiu and He, 1984). However, high fertility means that there are few couples who want only one child, not necessarily that there is less sex preference. Actually, one-child policy is not strictly applied to some areas consisting mostly of minority populations. Since there are, among minorities, few couples with only one child and even fewer who want to promise to have only one child, NAT1 is ill-suited to measure sex preference among minorities because of the small number of minority couples who have accepted one-child certificates. Therefore, the problems of floor and ceiling effects and of the sampling variation become particularly acute. Panel A of Table 9 gives a series of loglinear models on the nationality data in Table 8.

The loglinear models on the nationality dimension confirm the existence of sex preference in China (nesting (A2) and (A3), we have χ^2=180.1−21.2=158.9 for 1 degree of freedom). But we cannot accept the assertion that Han and Menchu are significantly more sex preferential than other nationalities since the model of homogeneity (Model A3) fits the data very well (χ^2=21.21 with 18 degrees of freedom, BIC=−168.3). All the variations of sex preference among nationalities observed by Arnold and Liu can only be due to floor effects and/or sampling variability. We can conclude that all the nationality groups in China are homogenous in terms of sex preference.

(2) PLACE OF RESIDENCE

About twenty percent of the population in China was classified as "urban" in the 1982 census (State Statistical Bureau, 1984, p.87). This includes people living both in towns in the countryside and in suburban counties of large cities. Since urbanization is one of the major aspects of modernization, and modernization is believed to be the major force to reduce sex preference, we would expect that in urban areas there is less sex preference than in rural areas. Arnold and Liu correctly observed the variation of sex preference along this dimension. However, on the continuum of city, town, rural nonfarm village, and rural farm village, they found the highest level of sex preference in towns, followed by the two types of rural villages. This is an anomaly which we will address using loglinear models.

TABLE 9: Loglinear Models of Sex Preference Data in Table 8

Model	Descrition	L-2	D.F.	BIC
	A: Nationality			
(A1)	Sex+Cert+Nation	1411	28	1116
(A2)	(A1)+Nation*Cert	180.1	19	-20.0
(A3)	(A2)+Cert*Sex	21.21	18	-168.3
(A4)	(A3)+Nation*Sex	6.767	9	-88.0
	B: Place of Residence			
(B1)	Sex+Cert+Place	5990	10	5885
(B2)	(B1)+Place*Cert	276.2	7	202.5
(B3)	(B2)+Cert*Sex	117.8	6	54.6
(B4)	(B3)+Place*Sex	26.79	3	-4.8
(B5)	(B3)+PlaceL*Sex+ +PlaceL*Cert*Sex	5.152	4	-37.0
	C: Educational Attainment			
(C1)	Sex+Cert+Edu	4896	13	4759
(C2)	(C1)+Edu*Cert	270.1	9	175.3
(C3)	(C2)+Cert*Sex	110.2	8	26.0
(C4)	(C3)+Edu*Sex	24.98	4	-17.1
(C5)	(C3)+EduL*Sex+ +EduL*Cert*Sex	14.68	6	-48.5
sample size = 37426				

Note: Sex = Sex of child of one-child couples, boy vs. girl.
Cert = Acceptance of one-child certificates, yes vs. no.
Nation = Nationality, 20 categories.
Place = Place of residence, 4 categories.
PlaceL = Linear scoring of Place, with city=1, town=2, etc..
Edu = Educational Attainment, 5 categories.
EduL = Linear scoring of Edu, with illiterate=1, elementary=2, etc..
L-2 = log-likelihood ratio statistic, Glim output.
D.F. = Degrees of freedom.

Panel B of Table 9 displays the results of a set of loglinear models. Here the model of homogeneity of sex preference (Model B3) clearly for the first time cannot hold. The model of homogeneous odds ratio (Model B4), superior to Model B3, does not fit very well (L^2=26.79 with 3 degrees of freedom, BIC=−4.8). Since we do not have many degrees of freedom left to test three-way interaction, we take the advantage of the ordering of the Place variable. We make PlaceL a linear transformation of Place, with city=1, town=2, rural nonfarm=3, and rural farm=4. If the sex preference varies inversely with the degree of urbanization, we should expect that PlaceL will explain much of the association in the cross-classified table. Model B5 confirms our speculation with very good fit (L^2=5.152 with 4 degrees of freedom, BIC=−37.0). Model B5 says that sex preference in China varies with place of residence along a continuum with roughly even intervals, in two aspects: marginal distribution of sex of one-child and the odds ratio of accepting a one-child certificate.

(3) EDUCATIONAL ATTAINMENT

A similar story can be told about the dimension of educational attainment. Arnold and Liu used five categories of education: illiterate, elementary school, junior high school, senior high school, and university. We expect to see that there is less sex preference among couples with better educated wives. The failure of Arnold and Liu's measure to place couples with wives of elementary school education as being less sex preferential than couples with illiterate wives is troublesome. The root of the problem is, again, floor and ceiling effects and sampling variability.

In Panel C, Table 9, we run the same set of models as we did in Panel B. It is clear that the model of homogeneous sex preference (Model C3) needs to be rejected. The model of homogeneous odds ratio (Model C4) fits marginally acceptable under

BIC criterion (BIC=−17.1) but unsatisfactorily by log-likelihood ratio test (L^2=24.98 with 4 degrees of freedom). However, Model C5, representing the hypothesis of equal-interval gradient of sex preference along the dimension of mothers' educational attainment defined in Table 8, is a superior model (L^2=14.68 with 6 degrees of freedom, BIC=-48.5).

A question arises from the above conclusion. If sex preference varies with place of residence and educational attainment, and the levels of urbanization and of average education are regionally heterogenous in China, why could we not observe regional variation of sex preference, which might be a result of variation of urbanization and education? There is some evidence that measures AL3 and LOR1 have negative correlation with urbanization and positive correlation with illiteracy rate and total fertility rate. The evidence, however, is not strong enough to be statistically significant, judged by our loglinear models. There are two possible reasons why the regional variation of sex preference did not show up in our previous analysis. One is that the effects of these variables of socio-economic development are compensated by the effects of other correlated variables. For example, in less developed regions, the age composition is younger and people marry earlier. If young couples are less sex-preferential than older couples, the effect of age will reduce sex preference in less developed regions. Another reason is that the effects of education and residency are not so strong and the levels of urbanization and average education not so variant that their effects on regional variation of sex preference cannot be ascertained from the present data. After all, our data do not permit us to measure the degree of sex preference on a "true" scale. In any case, we did not observe regional variation of sex preference without controlling for the level of development. It seems reasonable to assume that with controls of the level of development, there should be less regional variation of sex preference. Therefore, the hypothesis of homogeneity of sex preference in China would be supported more firmly.

Conclusion

From the preceding analysis, which takes account of floor and ceiling effects and sampling variability, we found that sex preference in China is largely homogenous across regions and nationalities. This conclusion is not entirely in accordance with the hypothesis that it is the Confucian traditions that are responsible for the existence of sex preference. Deeper structural components, such as economy, family structure, education, and residential arrangements might have their impact, directly or indirectly, on the widespread sex preference in China. As long as sons are more valuable to a family, either because sons bring more money home or because in general sons compete better in the system of social stratification than daughters, sons are likely to be preferred to daughters. Confucianism has its effects by providing a rationale for son preference when necessary. This explains why sex preference in China still exists after the many years of efforts by the ruling Communist Party of China to teach egalitarian values and to set up formal laws and policies of reducing sex inequality (Arnold and Liu, 1986; Williams, 1976).

Our finding of the variation of sex preference along the dimensions of education and place of residence supports our theory that changes in social, economic, and cultural structures are necessary for further reducing sex preference in China. With the modernization program now under way in China, it is predictable that sex preference will be reduced in the future. But the process will be slow because the current program of modernization is a double-edged sword. On the one hand it promotes changes in people's values and styles of life; on the other hand, however, the newly opened economic system with emphasis on individual families (particularly in the countryside) seems to favor families with more sons.

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