

**Determinants of Prenatal Sex-selective Abortion in Rural
China: A Case Study in Henan Province**

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Abstract

The high sex ratio at birth in China has been the center of focus for demographers for a few decades. Previous studies show female infanticide, underreporting of female births, and prenatal sex-selective abortion are the three potential causes of the rising sex ratio at birth in China. In addition, recent studies imply that prenatal sex selection has been the leading cause of the rising sex ratio at birth in China. However, research to date has rarely addressed the phenomenon of sex-selective abortion systematically. A survey of “Women’s Fertility Preferences and Behaviors in Rural China” conducted in rural Henan in 2001 makes it possible to show a clearer picture of prenatal sex-selective abortion in rural China. Using the data from this survey, this paper demonstrates rural women’s knowledge, attitudes, and practice with regard to prenatal sex selection and analyzes the main determinants of sex-selective abortion. Results show that prenatal sex selection is commonly practiced in the studied area and it has been the predominant, if not the sole, cause of the high sex ratio at birth. Moreover, the gender of the fetus, sex composition of prior siblings, whether the pregnancy is permitted by the local birth plan, and whether ultrasound scanning was conducted during pregnancy, are important determinants of prenatal sex-selective abortion. Women’s age and education also play an important role in determining the practice of sex-selective abortion.

1. Introduction

China observed one of the most remarkable fertility changes during the late 20th century. On the one hand, the total fertility rate (TFR) in China decreased from 5.18 in the 1960s to 4.01 in the 1970s, and it further went down to 2.46 in the 1980s (Mu, 1995). Since the early 1990s, the TFR in China has been below the replacement level (2.10), and recent studies show that it was around 1.70-1.80 in 2000 (Yu, 2002; Wang, 2003).

On the other hand, the sex ratio at birth (SRB) in China started rising in the 1980s and has been elevated ever since. The SRB was 108.5 in 1981 (based on the 1982 population census--Zeng et al., 1993), which was still close to the biologically normal level¹. It increased to 111.3 in 1989 (based on the 1990 population census--State Statistics Bureau, 1993), and by 1999 it was 119.9 (based on the 2000 population census--Population Census Office under the State Council, 2002). Over the last two decades, the SRB in China has increased by more than 10%.

The overall SRB in China is now among the highest in the world after twenty years' sustained elevation. In addition, the SRB in rural China is much higher than that in urban areas. According to China's 2000 population census, the SRB in cities was 114.2, while it was 119.9 in towns and 121.7 in the countryside. The abnormally high sex ratio at birth

¹Based on empirical data from various sources, demographers estimate that the normal sex ratio at birth in a population should fall into the narrow interval between 103 and 107.

in China and the large difference between rural and urban areas have become the center of focus for both the Chinese scholars and the demographers abroad.

There have been many studies on the causes of the high SRB in China. Female infanticide, sex-differentials in birth underreporting, and sex-selective abortion are regarded as the three main causes of the high reported SRB (Hull, 1990; Johansson and Nygren, 1991; Zeng et al., 1993; Coale and Banister, 1994). In the early 1990s, there was a hot debate concerning which of these factors was the leading cause of the elevated sex ratio at birth in China. Most of the latest studies, however, suggest that sex-selective abortion has been the dominant cause of the rising SRB in China since the middle of the 1990s (Yan and Lu, 1995; Xie, 1998; Chu, 2001a; Qiao, 2004).

Currently, prenatal sex selection has become one of the hottest topics in the studies of Chinese population, partly in light of the upcoming social impacts such as the potential marriage squeeze (Guo and Deng, 2000). However, few studies to date provide direct evidence of prenatal sex selection, and even fewer investigate the mechanisms concerning sex-selective abortion systematically. As a result, our knowledge about prenatal sex-selective abortion in China is still very limited and a systematic study is highly demanded.

Suggested as the main channel to the rising SRB in China, the emergence of sex-selective abortion is abnormal per se and may have far-reaching social impacts. Examining the determinants of this phenomenon is critical for our understanding of not

only the underlying mechanism of the rising SRB, but also the whole story of the ongoing Chinese fertility transition. In this paper, I use the survey data collected in rural Henan in 2001 to analyze the main social and demographic factors affecting the practice of sex-selective abortion.

As the most populous province in China, Henan has a rural population of more than 70 million, which accounts for over 10% of the total rural population in China (Henan Statistical Bureau, 2001). Henan also has an extremely high SRB. Based on the 2000's Census, the SRB in Henan province was 130.3, one of the highest in China; furthermore, it was 116.7 in cities, 133.7 in towns, and 132.3 in the countryside (Population Census Office under the State Council, 2002). Because of the substantial regional differences in culture and socioeconomic development in China, the situation in Henan is never a full representative of China and the result in this study is not meant to be generalized to the whole Chinese society. However, the problem of the significantly imbalanced sex ratio at birth is prevalent in almost the whole country, and consequently, the study of the situation in rural Henan is meaningful in understanding the ongoing story of rural China.

2. Literature Review

Many studies have documented the characteristics of the significantly imbalanced SRB in China since the early 1990s. Hull (1990) shows that the SRB in rural China differs considerably from that in urban areas. Also, there is evidence in the study that the SRB displays significant parity-based pattern: normal for the first birth in general, while

abnormally high for the following births. In addition, Johnson and Nygren (1991) demonstrate dramatic differences between the sex ratios among children born within and outside the local birth plan. Compared with the largely normal sex ratios for live births within the plan, those for children born outside the plan are much higher. However, instead of addressing the issue of prenatal sex selection, these earlier studies try to rule out the possibility of prevalent prenatal sex selection in China based on their doubt on the availability of modern technologies of prenatal sex determination.

Zeng et al. (1993) confirmed the possibility of sex selection by demonstrating that the technology of prenatal sex identification and sex-selective abortion has been available in most areas of China since the late 1980s. In addition, their study of the high sex ratios for live births delivered in hospitals during 1988-1991 shows evidence that sex-selective abortion does exist in China, since neither birth underreporting nor female infanticide is possible in a hospital setting. Other studies of the sex ratio of the aborted fetuses in China also confirm the existence of prenatal sex selection. For instance, a study cited by Wu (1996) shows that over 85% of the aborted fetuses are females in a county in Zhejiang province during 1986-1990. A survey conducted by Chinese Population Information and Research Center (CPIRC) in Southeast China in 1993 also presents that the sex ratio for the aborted fetuses is only 86.7 (Wu, 1996). Unfortunately, neither of these studies provides direct information on sex-selective abortion, and our knowledge on prenatal sex selection is still very limited.

To my knowledge, the only quantitative analysis of prenatal sex selection in China is from Chu (2001a, 2001b). Based on the pretest survey data of “Women’s Fertility Preferences and Behaviors in Rural China”, Chu (2001a) suggests that the persistence of son preference in the wake of declining family size is the root cause of sex-selective abortion in China. The study shows that 84% of the respondents knew about ultrasound technology, over three quarters of them considered that prenatal sex identification by ultrasound Scanning was common in their communities, and about 11% of them had at least once sex-selective abortion. Using the same data, Chu (2001b) finds that the order of pregnancy, the gender of the fetus, and the sex composition of prior children, are the main determinants of prenatal sex-selective abortion. To specify, fetuses of higher orders of pregnancy, female, and those already having a sister are more likely to be aborted. However, the study considers little about the potential impacts from women’s socio-demographic characteristics as well as other important contextual factors.

As implied above, although a great body of literature has addressed the phenomenon of rising sex ratio at birth in China and agreement has been formed on the predominant role of prenatal sex selection, we still know very little about the prenatal sex selection per se as well as its determinants. However, the importance of these issues can never be neglected comfortably concerning the far-reaching impacts of the significant imbalance of SRB. Therefore, it is vital to investigate the practice of prenatal sex selection systematically and to develop the underlying mechanisms of this phenomenon. This is especially significant in light of the repeatedly highlighted importance of socio-

demographic factors in fertility transition as well as various fertility-related behaviors (e.g., Bongaarts 2003; Chen 2002; Qiao 2002).

3. Data Description

The data employed in this analysis are from the questionnaire survey of “Women’s Fertility Preferences and Behaviors in Rural China”, conducted by the Institute of Population Research at Beijing University, in Henan province in 2001. The survey collected detailed information on the respondents’ basic socio-demographic characteristics, and their knowledge, attitudes and practice (KAP) in relation to prenatal sex identification and sex-selective abortion. More importantly, the respondents’ pregnancy and fertility history is constructed in terms of the beginning and ending times for each pregnancy, incidences of ultrasound scanning during each pregnancy as well as the corresponding time, place, purposes and results.

Because of the prohibited nature of prenatal sex identification (Chu 2001a), prenatal sex selection is a very sensitive topic in China. In light of the potential difficulty induced by this, the survey used snowball sampling based on local kinship networks, instead of random sampling in the survey design, to ensure authentic and reliable data. It started from a village in central Henan and 18 local women with senior middle school education or above were trained as interviewers. The interviewers were asked to interview their female relatives, friends, and neighbors who were currently married and were of reproductive ages (aged below 45).

In this survey, 1,056 rural women were interviewed. The survey result shows that all respondents age from 18 to 45. The number of pregnancies for these women ranged from 0 to 7 and the majority of them had fewer than 5 pregnancies. Among the respondents, about 31% had at least one induced abortion, and over 12% admitted that they had conducted at least one sex-selective abortion². In addition, almost all the aborted fetuses were female³.

According to the data, 2,362 completed pregnancies are counted for these respondents in total. Among those pregnancies, about 18% (424 fetuses) were terminated with abortion, and over 6% (150 fetuses) were aborted because of the undesired gender. The sex ratio at birth is 116.9 for the live births counted in this survey, which is substantially higher than the normal level (103-107); however, the sex ratio at birth would have been very close to the normal level (about 100.7) if all the sex-selectively aborted fetuses had been born alive. Although it is not possible to reconstruct the sex ratio at birth had all the induced abortion been born alive because not all the sex information is available, it is already much clearer that sex-selective abortion accounts tremendously the high sex ratio at birth as reflected in the live births. In addition, the data also imply that the underreporting of sex-selective abortion may be largely negligible for the respondents under study⁴.

² Here we define an abortion is sex-selective if a fetus is aborted because of the undesired sex.

³ A few male fetuses were aborted due to errors in ultrasound scanning, i.e., the fetus was misreported as a female and turned out to be a male after abortion.

⁴ The sex ratio at birth is still lower than 132.3, reported in the 2000 Census for rural Henan. However, the period covered in our data is 1975 to 2001. It is almost impossible to calculate a reliable sex ratio at birth for each year considering our comparatively small sample size. A more detailed computation shows that the sex ratio at birth between 1980-1989 was 104, and it increased to 125 between 1990-2001.

The main weakness of the data is that based on the snowball sampling design, the survey does not assure a probability sample of rural women. As a result, the inferences from these data should be treated cautiously when addressing the whole population. To my knowledge, however, this is the first survey to collect such detailed information on prenatal sex selection in China. Concerning the information it collected, this survey still has great merit and is expected to be instructive in our understanding of the underlying mechanisms of prenatal sex selection.

4. KAP of Prenatal Sex Selection in Rural Henan

Knowledge

In the survey, respondents were asked whether they know that the sex of a fetus can be identified through ultrasound scanning, amniocentesis, or pulse diagnosis. For the positive response (answer “yes”), additional questions followed to investigate the detailed knowledge the respondent had and the source of that information. Table 1 displays the age-specific distribution of respondents’ knowledge on techniques of prenatal sex identification. It is no doubt that ultrasound scanning is the most popular technique of prenatal sex identification in rural China. The majority of the respondents (85.9%) know that ultrasound scanning can discern the sex of a fetus. In addition, as a traditional technique of prenatal sex-identification, pulse diagnosis is also well known among rural

women. About half of the respondents possess knowledge about this method. Comparatively, fewer respondents (6.3%) were informed about amniocentesis.

From table 1, it is also evident that both the knowledge of ultrasound scanning and amniocentesis decreases with age. This conforms to the diffusion process of the knowledge that modern techniques such as ultrasound scanning can be employed for sex identification purpose among rural women. As the application of modern techniques in prenatal sex identification became prevalent only in recent years, women in older cohorts had fewer related experiences and more restricted knowledge in general. For instance, for those women aged 40 and above, about one third of them did not know ultrasound scanning as a prenatal sex-identification technique, but for the youngest age group (aged below 25), almost everybody (98%) had the knowledge.

In addition, the knowledge of techniques for prenatal sex identification increases with educational attainment among the respondents in general (as shown in Table 2). About one quarter of the women with no higher than primary school education never heard of ultrasound scanning as a technique applicable to prenatal sex identification; however, the corresponding proportion is around one tenth for the women having at least junior middle school education. Concerning the knowledge of amniocentesis as a technique for prenatal sex identification, the corresponding proportions are 3% and 21% respectively for women with no more than primary school education and their counterparts with at least senior middle school education.

Furthermore, when they were required to compare the reliability of the three techniques in fetus's sex identification, over 80% of the respondents believe that ultrasound scanning is the most reliable, compared to less than 1% for amniocentesis, 1% for pulse diagnosis, and the remaining 17% said that they had no idea.

In short, most of the rural women interviewed in the survey are well informed with the techniques of prenatal sex-identification, especially ultrasound scanning. The prevalence of this knowledge supports the argument that the techniques of prenatal sex selection have been prevalent in China (e.g., Zeng et al.1993) and it implies the potential role played by prenatal sex-selective abortion in the rising sex ratio at birth in China.

Attitudes

Table 3 presents respondents' attitudes toward prenatal sex-selective abortion. Although the majority of the respondents (90.2%) think that prenatal sex-selective abortion is unfair to female fetuses, and about two thirds of them (62.5%) believe that it will lead to seriously imbalanced sex ratio in the future, there are still considerable women (19.3%) regarding it acceptable to assure a male birth by sex-selective abortion. This displays the inevitably socio-psychological basis for the prenatal sex selection.

More importantly, the socio-psychological basis demonstrated above is not the whole story of the prenatal sex selection. It is possible that respondents who considered that sex-selective abortion is not right may actually practice it. Table 4 shows that more than 8%

of women who oppose to prenatal sex selection in their attitudes did have the experience of sex-selective abortion. The complexity of fertility behaviors may result in the potential confounding relationship between attitudes and real practice. Therefore, it is important to examine the women's practice of prenatal sex selection.

Practice

The process of prenatal sex selection has scarcely been recorded directly in previous studies. However, the rural Henan survey affords detailed information such as the times, place, and purpose of ultrasound scanning during each pregnancy, and whether the respondent was informed of the sex of the fetus. All these valuable data make it possible to depict a frontal picture about the practice of prenatal sex selection by pregnancy order.

As presented in Table 5, the incidence of prenatal sex selection increases dramatically as the order of pregnancy goes higher. Firstly, the proportion of women conducting ultrasound scanning doubles (22.6% vs. 47.4%) from the first pregnancy to the fourth pregnancy and above. At the same time, the purpose of ultrasound scanning is much more likely to be sex identification among higher order pregnancies, and the proportion increases from 22.6% for the first to 90.3% for the fourth and above.

Because of the illegal nature of prenatal sex identification, rural women are supposed to be more likely to get ultrasound scanning from private clinics when they are eager to be informed of the sex of the fetus. The data demonstrate that for the first pregnancy, less

than one fifth of the respondents choose a private clinic to conduct ultrasound scanning. However, the corresponding proportion jumps sharply to about one half in the second order, and continues to go up to two thirds in the fourth and higher order pregnancy. In addition, a growing number of women know the sex of the fetus during pregnancy as the order of pregnancy increases. As shown in table 5, for the first pregnancy about 14.3% of respondents know the sex of the fetus, however, the corresponding proportion increases to over 40% for the fourth and higher orders.

Lastly, the trend of the actual sex ratios at birth by order of pregnancy implies that the risk for women to abort their higher order fetuses with undesired sex is higher. Consistent with the findings in previous studies (Hull, 1990; Zeng et al., 1993), the sex ratios increase dramatically in higher orders of pregnancies. For instance, in our data set, the sex ratio at birth for the first pregnancy is 96.9, even somewhat lower than the normal level. However, started from the second pregnancy, the sex ratios become abnormally high. It is 116.7 for births of the second pregnancy, 178.1 for the third, and 260.6 for births of the fourth and higher orders of pregnancy. These figures suggest that prenatal sex-selective abortion is more commonly conducted for the higher order pregnancies.

Figure 1 combines the information on the temporal trends of the number of pregnancies, abortions, and sex-selective abortions. It is clear that there were hardly any sex-selective abortions before 1990 in our data. However, the number of sex-selective abortions started rising circa 1990, and since 1994 more than 10% of the fetuses have been sex-selectively aborted each year. Again, this trend conforms to the introductory

process of Ultrasound B-machines in rural China as described by Zeng et al. (1993), and it also reflects the diffusion process of related knowledge and socio-psychological grounds for the practice.

5. Hypotheses and Model Specification

As has been mentioned above, prenatal sex selection illustrates significant patterns across cohorts and through educational gradients. Just as reflected in many other fertility-related behaviors, it is expected to observe profound socio-demographic effects in the determining mechanisms for this phenomenon. In addition, concerning the strong culture effect of desiring both son(s) and daughter(s) (“*ernv shuangquan*”) in rural China (Qi and Chu, 2002), the variables reflecting characteristics of fetuses and children ever born are expected to be relevant significantly to the practice of abortion.

As a result, the main hypotheses to be tested in this study are classified into two levels. On the one hand, a woman may have different probability to practice abortions for fetuses with different characteristics; on the other hand, given the characteristics of a fetus, different women may make different decision on abortion. In other words, there are both within context (women) variances and between context variances. Hence, a multi-level model is constructed on the probability that a fetus is aborted⁵.

⁵ Instead of using sex-selective abortion, I choose the probability of being aborted as the dependent variable in the model. There are two reasons. First, the proportion of sex-selective abortions in the data is comparatively small (6%). And second, some of the coefficients (such as the gender effect) will become extremely large and unstable if the probability of sex-selective abortions is regressed.

My level-1 (fetus) hypotheses are illustrated as follows:

Hypothesis 1: as suggested by the notion of “prenatal sex selection”, the gender of the fetus will affect the probability that a pregnancy is terminated with abortion. Given the strong son preference in rural China, female fetuses are more likely to be aborted. Theoretically, only if the gender of the fetus is known before the end of the pregnancy, it affects the probability of an abortion. Thus I use the variable “being informed of the gender of the fetus before the end of the pregnancy” to measure the effect of gender. It was recoded as a dummy variable with “1” if the fetus is known as a female, and “0” for others (when the gender of the fetus is male or unknown)⁶.

Hypothesis 2: the sex composition of prior siblings will affect the probability that a fetus is aborted. Previous studies show that those fetuses already having female siblings are more likely to be aborted (Chu, 2001b). Here I am expecting a significant interaction effect of the sex composition of prior siblings and the sex of the fetus per se. In this analysis, the variable indicating the sex composition of prior siblings is classified into four categories (no sibling, male sibling only, female sibling only, and both male and female siblings) for comparison purpose. The corresponding interaction terms are examined in the model.

Hypothesis 3: whether the fetus is permitted by local birth plan is an important factor that affects the probability of being aborted. Based on the study of Johnson and Nygren

⁶ Since very few fetuses that are known to be male are aborted, I merged the categories of “male” and “unknown” together in the analysis.

(1991), the sex ratios for live births outside the local plan are significantly higher than those for the births within the local plan. Similarly, female fetuses without birth permit are expected more likely to be aborted. In other words, it is expected to observe an interaction effect between the sex of the fetus and having a birth permit or not. I use a dummy variable to indicate if the fetus is within or beyond the local birth plan.

Hypothesis 4: whether ultrasound scanning was done during pregnancy will affect the probability that a fetus is aborted. Tell from the description results, ultrasound Scanning is the predominant technique used for prenatal sex identification. Thus I expect that the conduction of ultrasound scanning will increase the probability of a fetus being aborted. Concerning the strong son preference practiced in rural China, a female fetus with ultrasound Scanning is expected to be especially more likely to be aborted; in contrast, a male fetus with ultrasound Scanning is less likely to be aborted. A dummy variable is created to indicate whether ultrasound scanning is conducted during pregnancy. And the corresponding interaction is also included in the model.

Hypothesis 5: pregnancies with long space are more likely to be aborted. No prior studies examined the effect of the interval between pregnancies on the probability of abortion. However, considering the importance of spacing in fertility behavior, I include a dummy variable indicating long spacing (18 months or above) vs. short spacing (less than 18 months) in my model. My expectation is that the pregnancy waited for a long interval is more likely to be terminated with abortion, given all other things equal. This is based on the logic that spacing is one alternative to limit family size, so is the abortion,

and women with long spacing may have fewer desired family size than those with short spacing and then they may also more likely abort an undesired fetus. Since the 1st interval is actually the time between marriage and first pregnancy and has different meaning with the following intervals. I also add a variable indicating for long spacing among higher order pregnancies.

The descriptive statistics of all the fetus-level (level 1) independent variables mentioned above are summarized in Table 6. In addition to the hypothesized importance of the fetus-level variables, I propose that the social and demographic characteristics of women also have an effect on the propensity to conduct abortion. And the level-2 (woman) hypotheses are demonstrated in the following:

Hypothesis 6: mother's age will affect the probability that she had an abortion. Given other variables constant, young women are expected to be more likely to have sex-selective abortions than their older counterpart, in light of the diffusion process of both the technology and the knowledge of prenatal sex determination. In this study, I use 5-year age groups to examine the potential impacts from the respondents' age.

Hypothesis 7: the effect of the respondents' education on the practice of abortions is more complex. In the long run, education may change the traditional culture of son preference and enhance the awareness of social wellbeing; consequently, it is expected to moderate the need of prenatal sex selection. In the short term, however, education may increase the knowledge about prenatal sex determination and have the virtual effect of

encouraging the practice of abortions. In this analysis, I assume the information effect of education is dominant concerning the period under study. That is to say, women with higher education are more likely to have abortions than those with lower education. Education is recoded into 3 categories (“primary school or less”, “junior middle school”, and “senior middle school or more”).

Hypothesis 8: the respondents’ sex preferences in fertility desire will affect their practice of abortions. Women who have strong son preference are more likely to resort to abortions to assure a male birth given the strict birth control policy in China. Based on the data, I use “the preferred sex if only one child is permitted (son, daughter, or indifferent)” to measure women’s differential sex preference in fertility desire.

Hypothesis 9: the respondents’ family structure and their status in the family may affect their practice of abortions. Just as various other fertility and contraceptive behaviors, sex-selective abortion is more likely to be a family decision rather than an individual decision. Since the leading purposes of having a son are continuing family line and old-age supporting (Qi and Chu, 2002), I expect that the woman whose husband is the only son in his family is more likely to have abortions because she will encounter more pressures for having a son from the extended family. Thus a dummy variable for whether the husband has male siblings is included.

Moreover, if the woman has higher family status, she may be more capable to resist the pressures from the extended family, and the sex preference of other family members

may be less likely to reinforce the possibility of prenatal sex selection to ensure a male birth. Consequently, I expect those women with higher family status are less likely to have abortions. In this study, I use two variables to measure women's family status. One measures women's economic authority, as denoted by their contribution to the total family income. The other measures women's authority in fertility-related decision making, that is, who makes the decision if there is disagreement on childbearing between husband and wife.

The summary statistics for level-2 (mother) independent variables are shown in Table 7.

Based on the hypotheses explicated above, I develop a two-level *logit* model with random intercept to estimate the probability that a fetus is aborted. To specify, the model will be:

$$\text{logit}(P_{ij}) = \beta_{0j} + \beta_1 S + \sum_k \beta_{2k} C_k + \beta_3 B + \beta_4 U + \beta_5 I + \sum_k \beta_{6k} SC_k + \beta_7 SB + \beta_8 SU + \mu_{ij},$$

where P_{ij} represents the probability that the fetus of the i th order of pregnancy for the j th woman is aborted, S indicates the gender of the fetus, C_k represent a series of dummy variables indicating the sex composition of prior siblings, B is a dummy variable indicating whether the fetus is outside the local birth plan, U is another dummy variable indicating whether ultrasound scanning was done during the pregnancy, and I is a dummy variable indicating long spacing vs. short spacing between pregnancies. SC_k , SB , and SU

indicate the corresponding interactions. The error term μ_{ij} follows a logistic distribution with mean of zero and variance of $\pi^2/3$.

β_{0j} is a random intercept which is determined by the mother's social and demographic characteristics, and it can be expressed by the following formula:

$$\beta_{0j} = \eta_{00} + \sum_h \eta_{01h} A_{hj} + \sum_l \eta_{02l} E_{lj} + \sum_m \eta_{03m} D_{mj} + \eta_{04} H_j + \sum_n \eta_{05n} F_{nj} + \sum_r \eta_{06r} Q_{rj} + \alpha_{0j},$$

where A_h , E_l , and D_m are three series of dummy variables indicating women's age, education, and sex preference respectively. H is a dummy variable indicating whether the respondent's husband is the only son in his family, F_n is a series of dummy variables measuring the respondent's contribution to her family income, and Q_r is another series of dummy variables indicating who makes the decision if there is disagreement on childbearing between husband and wife. The error term α_{0j} follows a normal distribution of $N(0, \sigma_\alpha^2)$.

To keep the model simple and parsimonious, I do not consider that the effects of the mother-level factors on the regression coefficients of those fetus-level variables.

6. Results

The model is estimated with STATA 8.0 by using “*xtlogit*”⁷ and the result is presented in Table 8. Since there are 38 respondents who have not completed their first pregnancy by the time of survey, these cases are not included in the analysis. Another two cases were dropped due to missing values of women’s income contribution to the family. Therefore, 2,360 pregnancies and 1,016 women were analyzed in the final model. Among the pregnancies, 424 (17.97%) were terminated with abortion.

The model shows that the characteristics of fetuses have very significant effects on the probability of being aborted. The gender of the fetus, sex composition of prior siblings, whether the pregnancy is allowed by local birth plan, and whether ultrasound Scanning was used during the pregnancy, are significant determinants that a pregnancy is terminated by abortion. However, the interval between pregnancies does not have a significant effect on abortion. The coefficients demonstrate that those fetuses either having prior siblings or beyond the local birth plan are more likely to be aborted, when other variables are controlled. In addition, the female fetus having only female siblings are especially more likely to be aborted. Moreover, the interaction between the incidence of ultrasound scanning and the gender of the fetus shows that female fetuses experienced ultrasound scanning are more likely to be aborted while male fetuses having experienced ultrasound scanning are less likely to be aborted, holding other variables constant.

Figures 2 through 4 give graphical demonstrations of these effects. Figure 2 presents the predicted probability of terminating a pregnancy with abortion by the gender of the fetus and the experience of using ultrasound scanning during the pregnancy for the

⁷ I also tried HLM5 and the result is very similar to that from STATA when LAPLACE option is specified.

women aged 25-34. It is clear that female fetuses experienced ultrasound scanning are more likely to be aborted than others. In contrast, if ultrasound scanning was conducted for a fetus and the parents do not know the gender of the fetus or they know it is male, the probability of being aborted is even lower than those not experienced ultrasound scanning. In sum, the experience of ultrasound scanning exaggerates the probability of being aborted only for female fetuses, while it has alleviating effect for male fetuses.

Figure 3 shows the probability of a fetus being aborted by its gender and whether it is beyond the local birth plan. No matter what the gender of the fetus is, pregnancies allowed by local birth plan are less likely to be terminated by abortion. In addition, the probability of being aborted for those “within-plan” fetuses that were not known to be female during pregnancy is virtually about zero. However, if the fetus is known to be a female and the pregnancy is outside the local birth plan, the probability of being aborted is even higher than 0.6.

Figure 4 shows the predicted probability of being aborted by the gender of the fetus and the sex composition of prior siblings. To illustrate the contrasts, only 4 interaction effects are displayed in the figure. It is clear that for those fetuses that are known to be female and have only female siblings, the probability of being aborted is as high as 0.9, which means almost all of those fetuses will be aborted. On the contrary, if a female fetus has male siblings only, the probability of being aborted is not significantly different from a male or sex-unknown fetus that has only female siblings. Moreover, for those fetuses that are not known to be female and have male siblings only, the probability of being

aborted is also a little bit higher, although not as high as the known-as-female fetus with only female siblings. These results are consistent with prior studies that rural women not only have strong son preference, but also hope to have both sons and daughters especially after their son desire has been ensured (Qi and Chu, 2002).

Besides the significant effects of the characteristics of the fetus, the model also demonstrates that mothers with different socio-demographic characters have significantly different propensity to practice abortions. Both age and education have significant effects. The coefficients for age groups show that the younger the woman is, the more likely she is to abort a fetus, when other variables are controlled. This is consistent with the hypothesis that modern technology of prenatal sex identification and related knowledge may be less available for those old women when they experience their peak periods of fertility. Although there is no difference in the propensity to conduct abortions between those women with primary schooling or less and those with junior middle schooling, women with senior middle schooling or more are significantly more likely to terminate a pregnancy by abortion. This suggests that highly educated people are more likely to take the advantage of information and technology at the beginning of the diffusion process in a society.

Contradictory to the hypothesis, women expressing strong son preference do not resort to abortion more than other women. Actually the coefficient shows that women who do not have sex preference are more likely to practice abortions than women who have son preference, but the effect is only marginally significant. The possible reason is

that fertility behaviors are more likely to be made by a family rather than by women themselves, and thus their preferences may not match their practical behaviors perfectly. Furthermore, women's sex preference in fertility desire may change across time, and it may be affected by their actual sex composition of children ever born. The result also shows that whether the husband is the only son of his parents does not have significant effect on the wife's practice on abortions, after controlling for other variables. Similarly, both women's contribution to the family income and whether the couple has disagreement on childbearing do not significantly affect women's decision in abortions, but the coefficients of the latter do show the expected directions.

In sum, the model demonstrates that the gender of the fetus, sex composition of prior siblings, whether the pregnancy is permitted by local birth plan, and whether ultrasound scanning was used during pregnancy, are the important factors that determine the probability of a fetus being aborted. In addition, women's age and education also affect the propensity of aborting a fetus when the fetus's characteristics are given.

7. Conclusions

Although prenatal sex identification and sex-selective abortion has been prohibited by the Chinese government since the mid-1980s, many studies show that prenatal sex-selective abortion is one of the leading causes of the rising sex ratio at birth in China. However, systematic studies of sex-selective abortion are still largely scarce. Although this situation is less surprising as the sensitivity of the topic is taken into consideration,

systematic research is highly demanded and will inevitably contribute to our understanding of the underlying mechanisms.

In this paper, I employ the data from a snowball sampling survey conducted in rural Henan to find out direct evidences of prenatal sex selection and to investigate its proximate determinants. The data show that most women under study possess sufficient knowledge about the modern techniques of prenatal sex identification, especially ultrasound scanning. A moderate proportion of the rural women believe that prenatal sex selection is an acceptable way to assure a son. By examining the detailed pregnancy and fertility history, it is clear that prenatal sex-selective abortion is more commonly practiced in the higher order pregnancies.

The data also illustrates that the temporal trend of the practice in prenatal sex-selective abortion conforms well to that of the rising sex ratio at birth. In addition, a simple computation suggests that sex-selective abortion is the predominant cause of the imbalance of sex ratio at birth in our sample. If the sex-selectively aborted fetuses had been born as live births, the sex ratio at birth should have been very close to the normal level in our data.

A two-level *logit* model is developed to analyze the main determinants of sex-selective abortion. Results show that a fetus is much more likely to be aborted if it is female, has no elder brothers, and/or if it is beyond the local family plan. In addition, women's socio-demographic characteristics have significant effects on their propensity to

terminate a pregnancy with abortion. Those women who are young and highly educated are more likely to resort to abortion. This is consistent with the diffusion process of new technology and knowledge in a society. Combining the temporal tendency as demonstrated in figure 1, the data seem to suggest that prenatal sex-selective abortion may become more and more popular in rural China in the near future and the sex ratio at birth may continue to rise.

Compared to female infanticide and underreporting of female births, prenatal sex-selective abortion is the only factor that leads to the imbalance of the actual sex ratio at birth. Moreover, since the prenatal sex identification using ultrasound scanning is considerably reliable only after the second trimester, a sex-selective abortion is generally a late abortion (Chu, 2001b). As reflected in this dataset, a sex-selective abortion usually happens in the fifth or sixth month of a pregnancy. Therefore, the repeatedly addressed negative impacts of a late abortion on women's health deserve more attention from the whole society.

Finally, it is important to restate the point that the data used in this analysis are from a snowball sampling. Therefore, the results found in this article are not meant to represent the situation of the whole population. Further studies are highly demanded before we can be confident to draw decisive conclusions about the situation of prenatal sex selection in contemporary Chinese society.

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Table 1 Knowledge of Techniques of Prenatal Sex Identification by Age (%)

Age	Technique			N
	Ultrasound Scanning	Amniocentesis	Pulse diagnosis	
below 25	98.2%	10.0%	40.0%	110
25-29	96.2	9.0	43.6	234
30-34	85.3	5.7	50.8	333
35-39	79.8	3.7	51.8	272
40+	68.2	4.7	52.3	107
Total	85.9%	6.3%	48.5%	1,056

Table 2 Knowledge of Techniques of Prenatal Sex Identification by Education (%)

Education	Technique			N
	Ultrasound Scanning	Amniocentesis	Pulse diagnosis	
Primary S. or less	74.3%	3.0%	44.0%	300
Junior M. S.	90.7	5.5	49.9	656
Senior M. S. or above	89.0	21.0	53.0	100
Total	85.9%	6.3%	48.5%	1,056

Table 3 Attitudes toward Prenatal Sex Selection

Attitude	Yes	No	Unclear	Total	N
It is right to assure a son by sex-selective abortion	19.3%	61.2	19.5	100.0%	1056
It is fair for females to do sex-selective abortions	1.8%	90.2	8.1	100.1%	1056
It will lead to more male births than female births	62.5%	15.0	22.6	100.1%	1056

Table 4 Cross-tabulation of Attitudes and Practice with Regard to Sex-selective Abortion

Experience of Sex-selective Abortion	It is right to assure a son by sex-selective abortion		
	Yes	No	Unclear
Yes	25.0%	8.5%	10.2%
No	75.0	91.5	89.8
Total	100%	100%	100%
N	204	646	206

Table 5 Practices of Prenatal Sex Identification by Order of Pregnancy

Ultrasound Scanning		Order of Pregnancy			
		1	2	3	4+
Do ultrasound scanning before birth	Yes	22.6%	25.4%	35.8%	47.4%
	No	77.4%	74.6%	64.2%	52.6%
	N	1038	778	388	196
Place of the 1st time to do ultrasound scanning	Hospital	63.0%	44.9%	36.7%	23.7%
	FPP station	18.7%	8.6%	10.1%	9.7%
	Private clinics	18.3%	46.5%	51.8%	65.6%
	N	235	198	139	93
Primary purpose of ultrasound scanning	Sex identification	22.6%	69.2%	87.1%	90.3%
	Health check	77.4%	30.8%	12.9%	9.7%
	N	235	198	139	93
Know the sex of the fetus before birth	Yes	14.3%	21.3%	32.7%	43.4%
	No	85.7%	78.7%	67.3%	56.6%
	N	1038	778	388	196
Number of live births		957	481	228	119
Sex ratio at birth		96.9	116.7	178.1	260.6

Table 6 Descriptive Statistics of Level1 (Fetus) Independent Variables

Variable	Frequency	Percentage(%)	Total
<u>Outside the local birth plan</u>	828	35.1	2,360
<u>Having Ultrasound Scanning</u>	641	27.2	2,360
<u>Know the fetus is Female</u>	264	11.2	2,360
<u>Sex Composition of Prior Siblings</u>			
No child	1,103	46.7	2,360
Son only	451	19.1	2,360
Daughter only	701	29.7	2,360
Both sons and daughters	105	4.5	2,360
<u>Long interval between pregnancies</u>	1,093	46.3	2,360
<u>Long interval of higher order pregnancies</u>	990	42.0	2,360

Table 7 Descriptive Statistics of Level 2 (Mother) Independent Variables

Variable	Frequency	Percentage(%)	Total
<u>Age</u>			
Below 25	86	8.5	1,016
25-29	224	22.1	1,016
30-34	232	32.7	1,016
35-39	268	26.4	1,016
40+	106	10.4	1,016
<u>Education</u>			
Primary S. or less	297	29.2	1,016
Junior M. S.	628	61.8	1,016
Senior M. S. or above	91	9.0	1,016
<u>Husband has brothers</u>	823	81.0	1,016
<u>Sex Preference</u>			
Son	602	59.3	1,016
Daughter	21	2.1	1,016
Indifferent	393	38.7	1,016
<u>Income Proportion</u>			
None	73	7.2	1,016
1-24%	423	41.6	1,016
25-49%	379	37.3	1,016
50-100%	141	13.9	1,016
<u>Who made decision if having disagreement on childbearing</u>			
No disagreement	531	52.3	1,016
The woman	45	4.4	1,016
The husband	81	8.0	1,016
The couple	359	35.3	1,016

Table 8 Two-level *Logit* Model of Determinants of Induced Abortions (N of fetuses = 2,360, and N of mothers = 1,016)

Independent Variable	β	S.E.	<i>p</i>
Fetus-level Covariates			
<u>Knew the fetus is female</u>	0.1047	1.0562	0.921
<u>Outside the local birth plan</u>	1.1569	0.1917	0.000
<u>Did ultrasound Scanning</u>	-1.1350	0.2520	0.000
<u>Sib-size Structure (“no child” omitted)</u>			
male only	3.7503	0.4339	0.000
female only	3.3797	0.4268	0.000
both male and female	4.9360	0.4848	0.000
<u>Long spacing</u>	1.0428	0.8057	0.196
<u>Long spacing * Not 1st pregnancy</u>	-1.0935	0.8237	0.184
<u>Knew the fetus is female * Outside the local birth plan</u>	-0.7810	0.4582	0.088
<u>Knew the fetus is female* Did ultrasound Scanning</u>	1.4276	0.9203	0.121
<u>Knew the fetus is Female* Sib-size structure</u>			
female*male only	-0.4032	0.9096	0.658
female*female only	3.0693	0.7177	0.000
female*both male and female	-0.5252	1.7189	0.760
Mother-level Covariates			
<u>Age (“below 25” omitted)</u>			
25-29	-2.0115	0.4860	0.000
30-34	-2.6522	0.4828	0.000
35-39	-3.6248	0.5018	0.000
40+	-3.9346	0.5386	0.000
<u>Education (“primary schooling or less” omitted)</u>			
Junior M. S.	-0.0698	0.1647	0.672
Senior M. S. or above	0.5755	0.2670	0.031
<u>Sex Preference (“son” omitted)</u>			
daughter	0.0887	0.7542	0.906
indifferent	0.3120	0.1592	0.050
<u>Husband has brothers</u>	-0.1478	0.1959	0.451
<u>Income Contribution (“zero” omitted)</u>			
1-25%	-0.4309	0.2801	0.124
25-49%	-0.1566	0.2776	0.573
50-100%	0.3621	0.3190	0.256
<u>Who made decision if Disagreeing on childbearing (“no disagreement” omitted)</u>			

The woman	-0.0082	0.3291	0.980
The husband	0.4619	0.2453	0.060
The couple	0.0769	0.1699	0.651
<u>Intercept</u>	-2.2372	0.5233	0.000
<u>$\ln(\sigma_a)$</u>	-1.9227	1.4276	

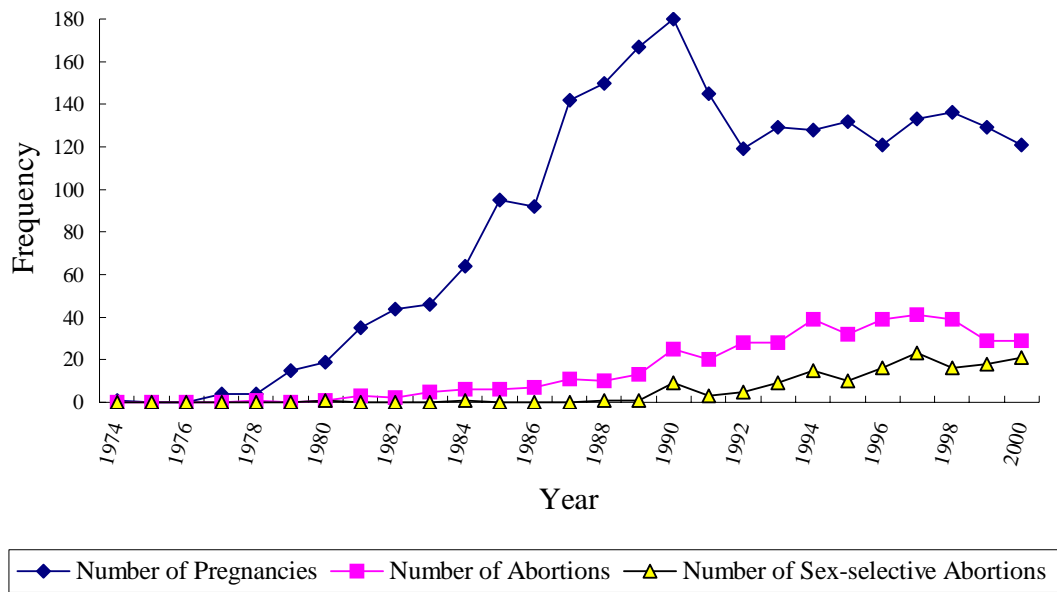


Figure 1 Trends of Number of Pregnancies, Abortions, and Sex-selective Abortions by Year

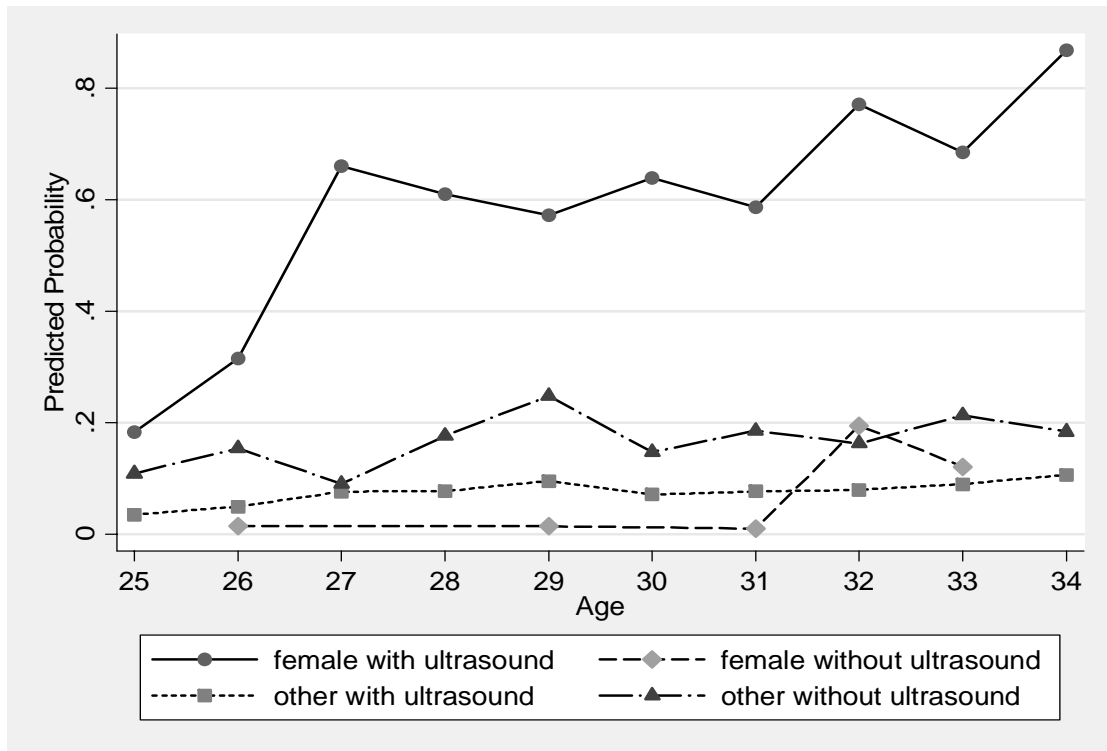


Figure 2 Predicted Probability of Induced Abortion by the Gender of the Fetus and Ultrasound Scanning

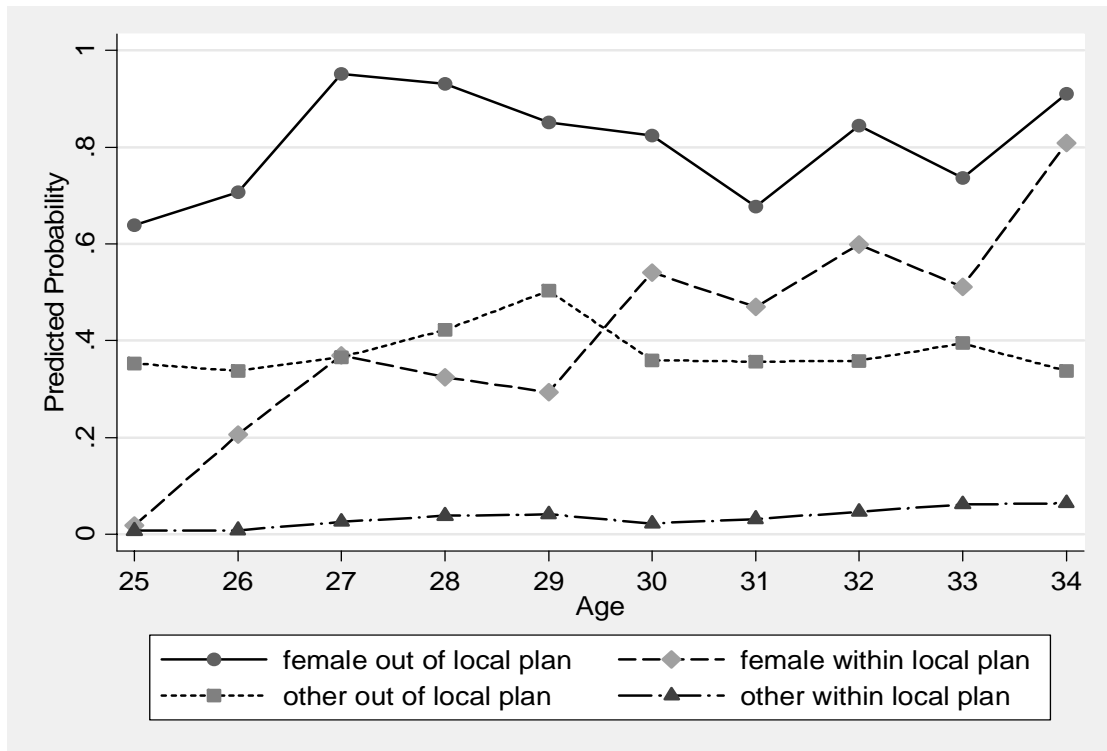


Figure 3 Predicted Probability of Induced Abortion by the Gender of the Fetus and Whether the Pregnancy is Within the Local Birth Plan

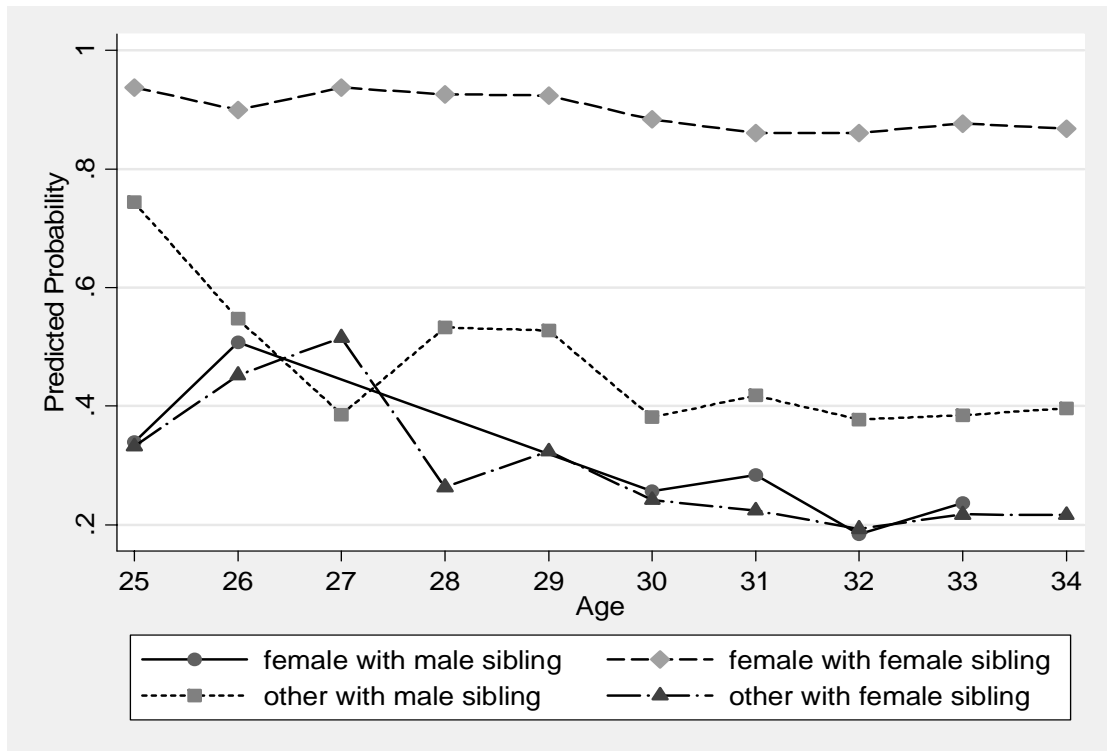


Figure 4 Predicted Probability of Induced Abortion by the Gender of the Fetus and Sex Composition of Prior Siblings