Changes in the Determinants of Fertility in Korea
–Analyses of Pregnancy Intervals and Outcomes–

Nam-Hoon Cho* · Namkee Ahn**

Korea completed the whole process of what is called the demographic transition to a low fertility and mortality level with the successful implementation of the national family planning program in 1962, and this has been accompanied by rapid socioeconomic development. Most of the fertility decline was due to a rising age at marriage and to lower marital fertility. The national family planning program, combined with the widespread practice of induced abortion, has played an important role in reducing marital fertility, particularly among older women.

This paper aims, therefore, to examine the determinants of fertility and their changes over time in an effort to suggest future population policy directions for Korea. The analysis is divided into two parts: estimation of pregnancy intervals by applying the proportional hazards model, and estimation of the determinants of fertility by adopting the logistic regression model to find out whether a pregnancy terminates in a live birth or in an abortion. In both analyses the sex included as the main explanatory variables. A woman's education has been shown to have a significant effect on delaying the timing or on the wife's age at first pregnancy, but its effect on the pace of subsequent pregnancies is much smaller and often positive.

On the other hand, the woman's education has a consistently positive effect on the probability of a pregnancy ending in an abortion although the effect shows a steady decline over time. Form first parity, the sex composition of previous children stands out consitently as the most important factor in deciding both the pace of pregnancy and its outcome. The pregnancy risks of the woman with sons are reduced by almost one-half at the second and third parities. The probability of a pregnancy ending in an abortion also increases substantially when parents already have a son. The decline of the desired family size but the sustained strong son preference has made the sex of children a more important factor in the determination of Korean fertility. The woman's education, on the other hand, has become a less important factor.

* Senior Fellow, Korea Institute for Health and Social Affairs

** Visiting Researcher, Korea Institute for Health and Social Affairs.

I. Introduction

It is commonly recognized that socioeconomic fators affect and are, affected by demographic variable. The empirical evidence of the positive feedback effects of socioeconomic and demographic interactions have been well excercised in Korea during the last three decades. The national family planning program was initiated in 1962 in the government's Five-Year Economic Development Plan. The successful implementation of a series of five-year economic development plans has resulted in a sustained rate of economic growth of more than 8 percent per annum since 1962, which has, in turn, contributed to higher levels of income, better health, educational attainment, and a rising status for women. In 1991, per capita GNP was US$6,498 and 97.2 percent of middle school students enrolled in high schools: infants and maternity mortality rates dropped to 12.8 per 1,000 and 3 per 10,000 live births, respectively. The medical insurance system has covered the entire population since 1988: the life expectancy was 66.9 years for men and 75.0 per women. Mean age at first marriage of women increased from 21.6 years in 1960 to 25.5 in 1990 (National Statistical Office, 1992).

Concomitant with its socioeconomic development, Korea has experienced one of the fastest fertility declines in the world during this same period. The total fertility rate declined from 6.0 in 1960 to 1.6 in 1987, far below the replacement level, and it has been maintained at the same level since then. This dramatic change of fertility behavior has been accompanied by equally impressive socioeconomic development. In other words, this fertility change was due not only to the vigorous national family planning program that constituted an integral part of the government's economic development plans, but was also due to various socioeconomic developments that took place during the period. It is the goal of this paper to understand the changes in the determinants of fertility in relation to some important socioeconomic variables. In particular, it focuses on how important socio-economic and demographic factors have changed their influence on fertility over time.

Most previous fertility studies used children born or the mean closed birth intervals as dependent variables. These are inadequate measures to understand the complexity of fertility. The analysis of children born usually includes only old women who are beyond the childbearing age, and that of closed intervals can not incorporate open intervals. Recently, hazard models have often been used, because they can include all intervals, those closed as well as open, thereby avoiding the bias towards short intervals if only closed intervals are examined (Rodriguez et al., 1983: Richards, 1982). Most research in past years, however, focused on the examination of birth intervals between live births. This approach ignores the complicated nature of fertility. A child birth may be viewed as an outcome of a two-stage process. The first stage involves the pregnancy, and the second stage, which is relevant to those who becom pregnant, is the decision whether to terminate the pregnancy by induced abortion, or to carry through to a live birth. The analysis in this study consists of these two parts involved in a birth: the timing of pregnancy and its outcome.

The introduction of various modern contraceptives has made effective. Yet, it has been evident that induced abortion has played a significant role in helping couples to control their family size in many countries in Eastern Europe and South-East Asia. Korea is one of the countries which show a large number of induced abortions which have increased steadily over the last three decades. Although the absolute number of abortions and the increasing rate of induced abortions rate have been declining along with the increase in contraceptive practice rate, which was 79.4 percent of married women aged 15 to 44 in 1991, it is still at a very high level compared to the developed western countries. According to the 1991 national fertility and family health survey data used in this study, the induced abortion experience rate of the married women increased from 21 percent of all pregnancies to 1974, to 38, 44 and 49 percent during the periods of 1975 to 1979, 1980 to 1984 and 1985 to 1991, respectively.[1] As coluld be expected, the abortion rate shows a dramatic increase with parity. Of pregnancies since 1985, only 27 percent were aborted for childless parents while 46 percent were in families with on child and 81 percent of those with two children. In a study of fertility it has become just as important to know how each pregnancy ends as who becomes pregnant when.

In recent years, a variety of models for evaluating the impact of the family planning program on fertility have been constructed. The standardization approach is a composite of the crude birth rate that makes it necessary to sort out the amount of change in it that is due to the influence of either of its four major components: 1) proportion of women of reproductive age in the total population, 2) age structure of women of reproductive age, 3) proportion of married women of reproductive age, and 4) marital age specific fertility rates. This approach connote, however, account for the specific role of the program, and actually identifies the role of structural factors in determining the magnitude of the crude birth rate (United Nations, 1978). The results obtained by applying the standardization approach to Korean data show that the changes in the female age structure, in the proportion of married women, and marital fertility were among the principal factors that contributed to the decline of the CBR and of the GFR between 1960 and 1970.

On the other had, for the 1980 to 1990 period, the changes in the female age structure had a negative influence on the fertility decline, main-

1) Considering that the number of abortions tends to be underreported in the surveys which collect information by interviews or self-reporting questionnaires, the actual number is likely to be higher. See, for example, Jones and Forrest(1992). In the case of Korea, an unofficial number of abortions which is estimated approximately from the average number of abortions per doctor has gone up as high as twice the number of live births in recent years.

ly due to the increase in the female population that resulted from the baby boom in the late of 1950s (Cho, et al., 1992).

Another approach, which is used for evaluation the role of causal factors in fertility change, is the proximate determinant approach (see Bongaarts and Potter, 1983). This method emphasizes the intermediate variables, which determine the fertility outcome directly. Main intermediate variables are coital frequency, sterility, foetal losses, breast-feeding, amenorrhea, sexual abstinence, contraception and abortion. The study results based on the Bongaarts model reveal that the fertility outcome directly. Main intermediate variables are coital frequency, sterility, foetal losses, breasfeeding, amenorrhea, sexual abstinence, contraception and abortion. The study results based on the Bongaarts model reveal that the fertility decline in Korea in the past three decades was largely attributable to the decrease in the index of marriage, and to the increases in the indices of contraception and induced abortion, but the influence of induced abortion on the fertility decline has been decreasing in recent years (Cho, et al., 1992). In fact, the three principal factors believed to have excercised a strong influence on the fertility decline in Korea are the rise in the age at marriage, the increase in induced abortion, and the increase in contraceptive use. One estimate indicates that in 1970, the rise in the age at first marriage accounted for a 38.6 percent reduction in fertility, while induced abortion contributed 29.4 percent, and contraception 31.9 percent. In 1985, however, it is estimated that contraceptive use accounted for 50.3 percent, induced abortion 32.2 percent, and age at first marriage 17.5 percent of the fertility reduction (Han and Cho, 1987).

On the other hand, the socioeconomic variables, which economists or sociologists are interested in, are supposed to affect fertility only through these intermediate variables. The proximate determinant apporach can show how the socioeconomic variables affect fertility by changing the intermediate variables, This approach, however, requires detailed information on the intermediate variables. Such data are rarely available and even when available they are ridden with measurement and reporting errors. Many previous studies showed that some socioeconomic factors maintain their significant effects even after the important proximate variables were controlled (see Bumpass et al., 1986: Hobcraft and Kittle, 1984: Palloni, 1984: Trussell et al., 1985). In this study the effects of socioeconomic factors on fertility are estimated directly.

II. Variable Description

The analysis is composed of two dependent variables, and demographic and socioeconomic explanatory variables. Two dependent variables are pregnancy interval and the outcome of pregnancy.

A. Pregnancy Interval

Pregnancy interval is the duration in months until preganancy since the time of the last pregnancy. For the first pregnancy the interval starts at the minimum possible childbearing age. At the starting time of each interval the number of existing children specifies which parity this pregnancy belongs to, so the start of the interval, that is, the time of the last pregnancy, need not be the pregnancy time of the last living child if the last pregnancy did not result in a live birth. For every woman except those pregnant at the time of the survey there is one open interval starting from the time of the latest pregnancy. This interval is treated as censored at the time of the survey.

B. Outcome of Pregnancy

Pregnancy outcome is also used as a dependent variable. All pregnancies end in either a live birth, a still birth, or a spontaneous or induced abortion. Ongoing pregnancies are excluded from the analysis. While still births are very rare, less than one percent of total pregnancies, spontaneous abortions have not been low in number. What is interesting according to the data used in this paper is the sharp increase in recent years in the reported proportion of pregnancies ending in a spontaneous abortion among all-daughter families at the second parity; it is higher than 11 percent (49 out of 441) of pregnancies since 1985, while it is only 3 percent (25 out of 824) among those with one or two sons. Considering the great desire to have a son and to avoid another daughter among all-daughter families, this differential suggests a tendency among parents who chose abortion of a female fetus, determined by a screening test, to report this gender-selective induced abortion as a spontaneous abortion. This is the main reason spontaneous abortions, induced abortions and still births are included in the same category in this study. The dependent variable takes a value of zero if the pregnancy ends in a live birth and one otherwise.

C. Explanatory Variables

The explanatory variables included are the demographic and socioeconomic characteristics of the woman and her family Traditionally, Korean parents have shown strong son preferences for such reasons, as old-age support, provision of farm labor, carrying on the family line, and the practice of ancestor worship. Since a child's gender is not controllable, a problem facing parents at each parity is to decide what kind of contraceptive methods (or no method) to use and, when pregnant, whether to have an abortion or not. To measure this effect, the sex composition of existing children is included as a set of dummy variables, each representing the number of sons. More than two sons are included in the two-boy category. Given the strong preference for sons among Korean parents, the number of sons is expected to have a negative relationship with the probability of pregnancy. Similarly, it is expected to show a negative association with the chance for a pregnancy to end in a live birth.[2] The changes of these ef-

2) There were many studies which show son preferences in Korea using various methods. For example, Park

fects over time will be closely examined.

The woman's education is included as a set of dummy variables; less than 9, 9–11, 12–13, and more than 13 years of education. the negative effect of a woman's education is well documented across the world (see Cochrane, 1983; Jain, 1982; Kim, 1987). This relationship is often explained by the higher opportunity costs and the better knowledge associated with education of effective contraceptive methods. It is also found that as an economy develops and as the small family becomes the social norm, education loses its impact on fertility and sometimes reverses its effect due supposedly to the positive income effect. It will be shown in this paper that education becomes a less important factor over time in determining fertility in Korea.

To capture the effect of the tradition of continuing the family line through the eldest son, the study includes a variable denoting whether the husband is the eldest son or not. Other things being equal, it is supposed to have a positive effect on fertility. The place of residence has been shown consistently across the world to be an important factor affecting fertility. It is often argued that the greater knowledge and easier access to modern birth control methods in urban areas lead to a negative association between fertility and urban residence. This variable as used in this study, however, requires a note of caution since it records residence only at the time of survey. Although a more detailed residence history is desirable, current residence is usd due to a lack of data.

As essential controls, age at previous pregnancy, or current age for the estimation of first pregnancy and its square-term are also included in the model. Considering the rare occurrence of teenage childbearing in Korea, age is expected to show a declining effect on fertility. The husband's age and education are not included due to their high correlations, 0.93 in age and 0.77 in years of schooling, with the wife's age and education. The effects of the wife's age and education should, therefore, be interpreted as compounded by those of the husbands's.

III. Data

The data used in this study are drawn from the 1991 National Fertility and Family Health Survey of Korea conducted by the Korea Institute for Health and Social Affairs (KIHASA). The sample is a stratified nationwide probability sample based on the sampling framework used in the 1985 Population Census (see Kong et al., 1991 for more details on sampling). The total of 11,540 households were surveyed. The data used is based on interviews with 7,384 married women aged between 15 and 49. The information collected is mainly concerned with the respondent's marriage, pregnancy and birth,

(1983) compares the parity progression rates and the sex ratio of the last child, Bumpass et al. (1986) examines the birth interval, and Ahn (1991) attempts to measure the value of children by their sex and age. The former two studies used the 1974 Korean National Fertility Survey (Korean WFS), and the last one used the 1980 Korean Population and Housing Census.

family planning and work status. In particular, the woman's fertility history is recorded retrospectively, and serves as the main data for this study.

Pregnancy intervals are studied separately according to the number of living children by parity. Intervals of the fourth or higher parities are excluded from the analysis due to their rare occurrence.[3] The effects of socioeconomic variables may vary over time. Thus, the sample is analyzed separately for four cohorts which are divided by the starting year of each interval: up to 1974, 1975–79, 1980–84, and 1985 or later.

Table 1 Sample Means by Parity

Variables	First Pregnancy	Parity		
		One	Two	Three
Last Pregnancy : live birth=1	–	0.71	0.63	0.60
Number of existing sons				
No son	–	0.47	0.23	0.15
One son	–	0.53	0.50	0.40
Two sons	–	–	0.27	0.45
Year of last pregnancy				
−1974	–	0.27	0.23	0.30
1975~1979	–	0.19	0.22	0.33
1980~1984	–	0.24	0.27	0.25
1985~	–	0.31	0.28	0.11
Woman's education				
Primary or less	0.25	0.20	0.25	0.45
Middle school grad.	0.26	0.27	0.30	0.30
High school grad.	0.40	0.43	0.37	0.20
College or more	0.10	0.10	0.08	0.05
Husband : eldest son=1	–	0.44	0.46	0.49
Residence : Metropolitan area=1	0.47	0.61	0.61	0.56
Age at last pregnancy	–	24.5	26.9	28.9
Total Number	7,376	7,628	6,801	2,772

3) Less than 5 percent of pregnancies were at the fourth or higher parities. Most of those rare pregnancies ended in abortion. Especially, since 1985 the abortion rate was 82 percent among the high parity pregnancies.

4) There may be more than one interval for some women at a certain parity. For example, if a woman had an abortion between the first and the second live birth, she had experienced two pregnancy intervals at the first parity.

The sample characteristics are reported in Tabel 1 by parity. There were 7,324 women exposed to the first pregnancy, 7,628 pergnancy intervals at the first parity, 6,801 intervals at the second parity, and 2,772 intervals at the third parity.[4] In the samples of the first and second parities the proportion of intervals which belong to the cohort of later than 1979 were 55 percent, but only 36 percent in the third parity sample. Similarly, the proportion of women with at least a high school education is 53 percent among the first partity sample, but only 25 percent among the third parity sample. The mean age at the start of the interval goes up by about 2 years for each parity increase.

Ⅳ. Preliminary Analysis

For discussion convenience in the paper, a simple descriptive analysis was performed before fully integrated models were examined. We first compared the probability of becoming pregnant for the several specified durations of each interval according to the different levels of main variables, namely the year of pregnancy, sex composition, education, and the place of residence. We also compared pregnancy outcomes for those ending in a live birth and those ending in an abortion if those variables.

A. Probability of Pregnancy

The sample probability for a woman to become pregnant during the first t months of the interval conditional on being exposed at least for t months is estimated as the complement of the Karplan–Meier survival rate estimate (see, for example, Lawless 1982). First, We need to estimate the sample hazard rate at period t, h (t), as the proportion of women who become pregnant at the t_{-th} period of the interval of those who did not during the first t–1 periods. The sample survival rate in period t, S(t), then is the product of one minus the hazard rate up to period t. The probability for a woman to become pregnant during the first t period is the complement of the sample survival rate, that is,

$$P_j(t)=1-S_j(t)=1-\prod_{k=1}^{t}[1-h_j(k)] \qquad (1)$$

where the subscript j denotes the j_{-th} interval. Table 2.1 presents the probability of first pregnancy by age 19, 22, 25 and 27, and Tables 2b–2d present the probability of a pregnancy by the end of the 30th, 60th month since the previous pregnancy at the first, second and third parities. These tables slso show the probability of a birth in the parenthesis for comparison. Birth intervals are similarly estimated.

Age at first pregnancy shows a large difference between the different education levels and the difference is remains over time. By age 22, almost half of the women with less than middle school educations experienced their first pregnancy, but less than 20 percent and 10 percent did so among the women with high school and college educations, respectively. This indicates that the delay in the starting age of pregnancy is one of the major factors which warrants the negative association between education and the completed fertility rate.[5] A comparison by the place of residence shows some differences, but they are diminshing. For example, the probability of first pregnancy by age 25 showed 12 percent difference between metropolitan areas and others for women born before 1950, but the difference went down to 5 percent for those born after 1959.

Table 2.1 Life-Table Estimates of the Probability of First Pregnancy(Birth)

Birth Cohort	Woman's schooling in year	N	19(19.75)	22(22.75)	25(25.75)	27(27.75)
		Age at first pregnancy(birth)*				
~1949	All	1,857	0.06(0.06)	0.34(0.33)	0.73(0.71)	0.89(0.87)
	~ 8	940	0.10(0.10)	0.46(0.44)	0.83(0.82)	0.92(0.91)
	9~11	430	0.05(0.04)	0.29(0.28)	0.73(0.70)	0.90(0.89)
	12~13	387	0.01(0.01)	0.19(0.19)	0.59(0.57)	0.84(0.82)
	14+	100	0.01(0.01)	0.07(0.06)	0.37(0.34)	0.75(0.71)
1950~1954	All	1,374	0.05(0.05)	0.30(0.28)	0.70(0.68)	0.87(0.86)
	~ 8	424	0.10(0.10)	0.49(0.47)	0.84(0.83)	0.93(0.92)
	9~11	422	0.05(0.05)	0.31(0.29)	0.74(0.72)	0.88(0.86)
	12~13	414	0.01(0.01)	0.16(0.14)	0.60(0.57)	0.84(0.83)
	14+	113	0.00(0.00)	0.05(0.05)	0.43(0.41)	0.75(0.72)
1954~1959	All	1,819	0.04(0.04)	0.25(0.23)	0.67(0.65)	0.86(0.84)
	~ 8	314	0.12(0.10)	0.47(0.44)	0.86(0.83)	0.95(0.93)
	9~11	556	0.06(0.06)	0.33(0.31)	0.76(0.75)	0.90(0.88)
	12~13	790	0.01(0.01)	0.24(0.13)	0.59(0.57)	0.84(0.80)
	14+	159	0.01(0.01)	0.08(0.07)	0.40(0.38)	0.72(0.65)
1960~	All	2,326	0.04(0.03)	0.24(0.20)	0.66(0.60)	0.88(0.83)
	~ 8	143	0.17(0.13)	0.50(0.48)	0.87(0.83)	0.92(0.90)
	9~11	508	0.08(0.08)	0.41(0.39)	0.81(0.78)	0.94(0.92)
	12~13	1,339	0.01(0.01)	0.20(0.15)	0.66(0.58)	0.88(0.83)
	14+	336	0.01(0.00)	0.03(0.03)	0.34(0.29)	0.74(0.68)
	By the place of residence					
~1949	Metro-	965	0.08(0.08)	0.41(0.39)	0.79(0.78)	0.90(0.89)
	Non-metro	892	0.05(0.04)	0.27(0.26)	0.67(0.65)	0.87(0.85)
1950~1954	Metro-	716	0.08(0.08)	0.36(0.34)	0.76(0.75)	0.89(0.87)
	Non-metro	658	0.02(0.02)	0.24(0.22)	0.64(0.62)	0.86(0.85)
1955~1959	Metro-	984	0.05(0.04)	0.26(0.25)	0.70(0.69)	0.88(0.86)
	Non-metro	835	0.04(0.04)	0.23(0.21)	0.63(0.61)	0.84(0.81)
1960~	Metro-	1,228	0.05(0.04)	0.27(0.24)	0.68(0.63)	0.88(0.84)
	Non-metro	1,098	0.02(0.01)	0.21(0.16)	0.63(0.56)	0.87(0.82)

* To make the age at birth comparable to the age at pregnancy the probability of the birth is estimated at ages than used for pregnancy by 9 months or 0.75 year, the typical duration of pregnancy.

5) Age at marriage is very closely related to the age at first pregnancy, but it is not an appropriate explanatory variable in predicting the age at first pregnancy since they are both decision variables with highly correlated random errors. According to our data, the age at marriage increases by roughly one year for each increase in the level of education, with women with college educations three year older at marriage than those with primary educations.

Table 2.2~2.4 Life-Table Estimates of Probability(Birth) Pregnancy Since the Last Pregnancy(Birth)

(2.2) First Parity

Year of last pregnancy (birth)	Number of sons	Duration of interval in month			
		N	30	60	90
~1974	All	2,033(2,054)	0.70(0.59)	0.96(0.93)	0.98(0.96)
	One	1,085(1.092)	0.68(0.56)	0.95(0.92)	0.97(0.96)
	None	948(962)	0.73(0.63)	0.96(0.94)	0.98(0.97)
1975~1979	All	1,425(1,298)	0.77(0.64)	0.93(0.91)	0.95(0.94)
	One	791(705)	0.77(0.62)	0.93(0.89)	0.95(0.93)
	None	634(593)	0.77(0.67)	0.93(0.93)	0.95(0.95)
1980~1984	All	1,825(1,619)	0.72(0.53)	0.88(0.79)	0.91(0.84)
	One	969(844)	0.70(0.50)	0.86(0.77)	0.89(0.80)
	None	856(775)	0.73(0.55)	0.91(0.83)	0.94(0.89)
1885~	All	2,370(1,678)	0.66(0.41)	0.83(0.70)	–
	One	1,235(837)	0.65(0.36)	0.79(0.63)	–
	None	1,135(841)	0.68(0.46)	0.86(0.78)	–

(2.3) Second parity

Year of last pregnancy (birth)	Number of sons	Duration of interval in month			
		N	30	60	90
~1974	All	1,601(1,432)	0.61(0.40)	0.88(0.78)	0.91(0.81)
	Two	459(391)	0.57(0.33)	0.83(0.67)	0.87(0.72)
	One	700(700)	0.59(0.39)	0.87(0.78)	0.89(0.81)
	None	341(341)	0.70(0.48)	0.95(0.91)	0.97(0.94)
1975~1979	All	1,500(1.164)	0.56(0.29)	0.74(0.53)	0.75(0.56)
	Two	428(311)	0.49(0.19)	0.64(0.33)	0.66(0.36)
	One	759(572)	0.55(0.25)	0.72(0.50)	0.74(0.53)
	None	313(281)	0.66(0.49)	0.91(0.83)	0.92(0.86)
1980~1979	All	1,847(1,339)	0.42(0.14)	0.53(0.24)	0.56(0.26)
	Two	501(346)	0.36(0.09)	0.44(0.12)	0.46(0.12)
	One	951(682)	0.41(0.13)	0.52(0.19)	0.55(0.20)
	None	395(311)	0.50(0.24)	0.68(0.49)	0.72(0.55)
1885~	All	1,885(1,333)	0.30(0.07)	0.43(0.13)	–
	Two	418(316)	0.26(0.04)	0.35(0.07)	–
	One	949(671)	0.26(0.03)	0.36(0.05)	–
	None	518(346)	0.41(0.17)	0.63(0.35)	–

(2.4) **Third Parity**

Year of last pregnancy (birth)	Number of sons	Duration of interval in month			
		N	30	60	90
	All	849(794)	0.51(0.30)	0.75(0.59)	0.78(0.62)
	Three	114(110)	0.49(0.21)	0.71(0.49)	0.73(0.53)
~1974	Two	344(279)	0.44(0.17)	0.68(0.44)	0.73(0.47)
	One	111(102)	0.54(0.39)	0.78(0.69)	0.81(0.71)
	None		0.67(0.50)	0.90(0.87)	0.92(0.89)
	All	914(694)	0.48(0.21)	0.64(0.37)	0.65(0.40)
	Three	105(69)	0.42(0.06)	0.57(0.13)	0.60(0.14)
1975~1979	Two	319(227)	0.55(0.11)	0.58(0.23)	0.60(0.26)
	One	366(292)	0.52(0.25)	0.65(0.40)	0.66(0.41)
	None	124(106)	0.62(0.43)	0.82(0.76)	0.84(0.80)
	All	710(564)	0.34(0.10)	0.44(0.16)	0.46(0.17)
	Three	64(52)	0.19(0.04)	0.25(0.04)	0.28(0.04)
1980~1984	Two	228(165)	0.32(0.06)	0.42(0.08)	0.43(0.08)
	One	317(262)	0.32(0.10)	0.41(0.13)	0.42(0.14)
	None	101(86)	0.54(0.22)	0.72(0.48)	0.73(0.52)
	All	317(252)	0.25(0.11)	0.32(0.15)	–
	Three	7(6)	–	–	–
1985~	Two	45(45)	0.20(0.04)	0.24(0.12)	–
	One	150(150)	0.21(0.06)	0.27(0.06)	–
	None	51(51)	0.38(0.27)	0.52(0.42)	–

At first parity, the sex of the first child does not show much effect in the timing of the subsequent pregnancy except among the most recent cohort. Parents in early years seem to want to have the second child regardless of the sex of the first child. Since 1985, however, the probability of becoming pregnant by the 60th month of the interval is 7 percent lower among families with a boy than those with a girl. This suggests that the sex of children becomes important even at low parities as the desired family size decreases. The difference in the probability of a birth by the same interval duration is 15 percent, suggesting that more abortions are being practiced in families with a boy.

At the second parity, while the probability of both pregnancy and birth have declined, both show much larger differences according to the sex composition than at the first parity. The gap between different sex compositions is particularly large in the probability of birth, again suggesting a greater proportion of pregnancies ending in abortion among those with a male child, For example, the probability of a pregnancy and a birth by the 60th month of the interval are 0.63 and 0.35 for an all-daughter family while they are 0.35 and 0.07 for an all-son family. This pattern is also true at higher parities.

Surprisingly, a woman's education did not show any significant effect on the probility of pregnancy or birth (not reported). This seems to be attributable to the relatively homogeneous cultural and socioeconomic Korean society, and the effective family planning programs spread across education groups evenly. The effect of place of residence did not show either any noticeable change over time except that both the pregnancy and the birth probabilities were slightly lower in urban areas than in rural areas.

B. Pregnancy Outcome

As the second simple analysis, in the Tables 3.1 and 3.2, the pregnancy outcome is compared across groups by education level, place of residence and the sex composition of existing children. In general, the proportion of pregnancies ending with an abortion increases with parity and time. For the first pregnancy (Table 3. 1), the abortion rate has increased form 10 percent for pregnancies prior to 1975 to 30 percent for those since 1985. This increase seems to be attributable mostly to increased premarital pregnancies among more recent cohorts, but the proportions differ only slightly by educational level or place of residence.

From the first parity (table 3.2), the sex composition of existing children again stand out as the most important variable. Since the mid-1970s the probability of a pregnancy ending in a live birth is more than double for all-daughter families compared to all-son families at the second and third parities. Compared to rural areas, urban areas show higher proportions of aborted pregnancies at all parities, but the gap is shown to be narrowing.

Table 3.1 Percentage of First Pregnancy Ending By Abortion(sample size in parenthesis)

By Education	Year of pregnancy			
in year	~1974	1975~'79	1980~'84	1985~
~ 8	7(1,161)	115 (342)	15 (224)	38 (68)
9~11	12 (576)	14 (490)	18 (483)	25 (327)
12~13	14 (446)	15 (450)	16 (102)	32(1,232)
14+	16 (96)	16 (102)	22 (156)	30 (297)
By place of Residence	~1974	1975~'79	1980~'84	1985~
Metropolitan	13(1,038)	16 (677)	21 (759)	35 (888)
Non-metro	7(1,241)	14 (707)	15 (898)	28 (923)
All	10(2,279)	15(1,384)	18(1,656)	32(1,811)

Table 3.2 Percentage of Ending By Abortion(sample size in parenthesis)

Parity	No. of sons	Year of pregnancy			
		~1974	10975~'79	1980~'84	1985~
1	None	16 (952)	22(726)	30 (905)	42(1,249)
	One	19(2,027)	30(936)	37(1,105)	50(1,232)
2	None	23 (322)	28(336)	46 (370)	62 (445)
	Onw	32 (617)	54(710)	71 (787)	91 (587)
	Two	37 (370)	65(346)	79 (377)	94 (244)
3+	None	26 (114)	40(179)	52 (220)	63 (123)
	One	34 (253)	55(457)	77 (425)	85 (180)
	Two+	59 (385)	78(622)	87 (395)	93 (111)
Parity	by Region				
1	Non-metro	14(1,072)	22(827)	30(1,033)	44(1,2834)
	Metro	21 (907)	32(835)	37 (977)	48(1,198)
2	Non-metro	22 (722)	43(717)	61 (828)	77 (683)
	Metro	42 (587)	58(675)	74 (706)	86 (593)
3+	Non-metro	37 (477)	57(824)	70 (649)	76 (281)
	Metro	61(275)	77(434)	85 (391)	91 (133)
Parity	By Education				
1	Primary	12(1,063)	19(536)	27(342)	41 (179)
	Middle	18 (456)	26(532)	31(648)	43 (628)
	High	26 (377)	35(479)	37(843)	48(1,388)
	College+	39 (83)	33(115)	37(177)	44 (286)
2	Primary	23 (762)	39(587)	52(427)	73 (165)
	Middle	40 (300)	56(415)	70(532)	81 (427)
	High	46 (204)	63(317)	76(477)	83 (580)
	College+	53 (43)	60(73)	76(98)	87 (104)
3	Primary	37 (525)	59(799)	70(548)	76 (197)
	Middle	67 (147)	74(260)	82(276)	87 (106)
	High	62 (65)	70(168)	80(173)	83 (94)
	College+	60 (15)	81(31)	91(43)	88 (17)

In contrast to the case of pregnancy probability, there are significant differences in the pregnancy outcomed by a woman's education level. In particular, a woman with more than a primary education is much more likely to end her pregnancy with an abortion than those with less eduction, but the difference has been decreasing. This suggests that women with higher educations relied more often on abortion to control their fertility than less educated women, but the gap has been decreasing. Among the most recent cohort, education seems to be a minimal factor in determining either the pregnancy interval or the outcome of pregnancy.

V. MULTIVARIATE ANALYSES

Although the life-table estimates of pregnancy intervals or the cross-tabulations of pregnancy outcomes provide useful comparisons by the strata applied, they only suggest bivariate relationships where the effects of other correlated variables are not controlled. The multivariate hazards model for pregnancy intervals and the logistic regression model for pregnany outcomes are used to evaluate the effect of each variable of interest while controlling for other variables.

A. Determinants of Pregnancy Interval

The proportional hazards model introduced by Cox(1972) has been chosen as the analysis model. One advantage of this method is that it does not impose functional forms on the baseline hazard, thereby avoiding the potential bias arising if the imposed functional form is not true. The hazard rate(instantaneous occurrence rate) of pregnancy at the month of the t_{-th} month of the interval is assumed to take a proportional hazard form

$$h_i(t, z_i(t)) = h_0(t)\exp(z_i(t)'\beta) \qquad (2)$$

where $h_0(t)$ is an unknown time-specific baseline hazard, $z_i(t)$is a vector of covariates and β is the corresponding parameter vector which is unknown. A crucial assumption of the model is that members at one level of a given covariate experience a hazard each time that is proportional to that experienced by members of each of the other levels. Althouth the proportionality assumption is likely to be erroneous with some intermediate variables such as breastfeeding and mortality of previous child, it is less problematic with the socioeconomic or demographic variables included in this study.[6] The parameter vector β is estimated by the maximum likelihood method implemented in the statistical package, LIMDEP(Greene, 1991).

For convenience in discussion relative risks are also computed by taking exponents of β estimates. The estimation results are presented in Tables 4.1~4.3 for the first, the second and third parity, respectively.

1. Sex of Existing Children

As suggested in the simple analysis done earlier, the sex of existing children plays a decisive role in determining the pace of pregnancies even after controlling for other variables. The effect increases with parity. At parity one, parents with a son are about 15 percent lower in their risk of a subsequent pregnancy than

6) See Trussell et al., 1985 and Bumpass et al., 1986.

Table 4.1–4.3 Relative risk of Pregnancy

(4.1) First Parity

Covariates	Year at the start of interval			
	~1974	1975~'79	1980~'84	1985~
Previous pregnancy: live birth=1	0.37 (13.7)	0.39 (14.1)	0.52 (10.9)	0.50 (12.0)
No boy	reference (relative risk=1.00)			
One boy	0.84 (3.91)	0.97 (0.58)	0.83 (3.76)	0.82 (3.81)
Primary	reference (relative risk=1.00)			
Middle sch.	1.01 (0.09)	1.11 (1.34)	0.96 (0.53)	1.38 (2.38)
High sch.	1.01 (0.15)	1.04 (0.55)	0.99 (0.09)	1.35 (2.35)
College+	1.26 (2.25)	1.09 (1.52)	1.11 (0.94)	1.22 (1.37)
Eldest(husb)	1.02 (0.45)	1.06 (1.12)	0.98 (0.38)	1.21 (3.60)
Metro=1	0.11 (2.15)	1.03 (0.43)	0.94 (1.13)	0.98 (0.39)
Age at previous birth(Apb)	0.26 (5.78)	1.37 (5.37)	1.15 (3.29)	1.09 (1.89)
Apb-sq	0.99 (5.95)	0.99 (6.09)	0.99 (4.70)	0.99 (3.11)
Log-likelihood	−13,226	−8,609	−11,101	−10,365
Model Chi-sq.	215	214	163	188
Total Number	2,025	1,418	1,818	2,367

T–statistics of coefficient in parenthesis.

(4.2) Second Parity

Covariates	Year at the start of interval			
	~1974	1975~'79	1980~'84	1985~
Previous pregnancy: live birth=1	0.52 (0.09)	0.65 (6.29)	0.90 (1.46)	0.77 (2.87)
No boy	reference (relative risk=1.00)			
One boy	0.76 (4.31)	0.66 (5.70)	0.68 (5.06)	0.50 (7.52)
Two sons	0.70 (4.90)	0.53 (7.32)	0.54 (6.98)	0.49 (6.21)
Primary	reference (relative risk=1.00)			
Middle sch.	1.02 (0.24)	0.92 (1.12)	0.85 (1.76)	1.12 (0.66)
High sch.	0.86 (1.99)	0.76 (3.60)	0.82 (2.31)	1.17 (0.95)
College+	1.17 (1.12)	0.79 (1.85)	0.76 (1.99)	1.13 (0.58)
Eldest(husb)	1.03 (0.65)	1.13 (1.97)	1.14 (2.14)	1.16 (1.79)
Metro=1	0.91 (1.64)	0.94 (0.92)	1.05 (0.69)	1.03 (0.37)
Age at previous birth(Apb)	1.31 (4.06)	1.19 (2.78)	1.09 (1.61)	1.07 (0.93)
Apb-sq	0.99 (4.63)	0.99 (3.89)	1.00 (2.17)	1.00 (1.59)
Log-likelihood	−9,539	−7,598	−7,357	−4,185
Model Chi-sq.	118	143	73	86
Total Number	1,594	1,496	1,835	1,876

T–statistics of coefficient in parenthesis.

(4.3) Third Parity

Covariates	Year at the start of interval			
	~1974	1975~'79	1980~'84	1985~
Previous pregnancy: live birth=1	0.57 (5.38)	0.73 (3.28)	0.75 (2.26)	0.89 (0.47)
No boy	reference (relative risk=1.00)			
One boy	0.73 (2.65)	0.65 (3.62)	0.42 (5.91)	0.52 (2.63)
Two sons	0.54 (5.27)	0.52 (5.39)	0.38 (6.45)	0.59 (1.60)
Primary	reference (relative risk=1.00)			
Middle sch.	1.07 (0.73)	0.88 (1.29)	0.79 (1.64)	1.16 (0.53)
High sch.	0.95 (0.37)	0.91 (0.82)	0.78 (1.64)	0.73 (0.96)
College+	1.24 (0.94)	0.79 (1.22)	1.38 (1.51)	1.32 (0.51)
Eldest(husb)	1.09 (1.14)	1.35 (3.61)	1.25 (1.94)	0.79 (1.05)
Metro=1	0.82 (2.38)	1.00 (0.07)	0.94 (0.36)	0.73 (1.29)
Age at previous birth(Apb)	1.19 (1.47)	1.21 (1.73)	0.80 (2.48)	0.90 (0.71)
Apb-sq	0.99 (2.11)	0.99 (2.14)	1.01 (2.10)	1.02 (0.44)
Log-likelihood	-4,023	-3,798	-2,019	-445
Model Chi-sq.	73	54	61	17
Total Number	839	912	706	315

T-statistics of coefficient in parenthesis.

those without a son. At the second parity, the presence of a son reduces the pregnancy risk by more than 30 percent. whille the effect of any male child grows over time, reaching 50 percent reduction in pregnancy risks among the most recent cohort, the effect of two sons, compared to one son, has almost disappeared. This suggests a change in preference from two sons to one son. At the third parity, the gender effect is similar to that in the second parity. Again, the difference between one son and two or more sons has been reduced, from 20 percent among the earliest cohort to a negative 7 percent among the latest cohort.

2. Education

Women's education shows no significant effects at the first parity except for a college education for the 1974 cohort and a middle or high school education for the 1985 cohort. The college educated women of the 1974 cohort seem to have much shorter pregnancy intervals for the second child than those with less education. Similarly, among the most recent cohort, middle and high school graduates show about a 36 percent higher risk than primary school or less educated women. This might be explained by the shorter breast-feeding or efforts to speed up childbearing to secure at least two children among late marrying, highly educated women[7]. At the second parity the only consistent effect is shown among high school graduates. Their risk of a pregnancy is about 20 percent lower than for women with less than a middle school education. At parity two, education had no significant effect on subsequent pregnancy risks among the earliest cohort. For the pregnancy cohorts between 1975～1984 there is a substantial drop, about 20 percent, among high school and college educated women, but for the latest cohort, this educational difference has disappeared.

It is thought that there may be some interaction effects, that is, the differential effects of one variable by the value of another variable. When the interaction terms of sex composition with education and the place of residence are included(results not reported), none of them were significant either individually or jointly, while the main effect terms maintain their magnitudes and significance. This indicates that the effect of the sex composition is similar independent of the woman's education and her place of residence.

3. Other Controls

Whether the previous pregnancy ended in a live birth or with an abortion is included as an essential control. It is likely that an aborted previous pregnancy increases the risk of a next pregnancy due to the shorter postpartum amenorrhoea. This effect is, however, likely to be more pronounced at shorter durations of interval, thus violating the proportionality assumption. On the other hand, the previous abortion might be an indicator of the desire for the stopping or spacing of childbearing, leading to a negative association with the risk of subsequent pregnancies. At the first parity the risk of a subsequent pregnancy is higher by more than twice when the previous pregnancy has ended with an abortion, but at higher parities this effect goes down substantially. It seems that at low parities the biological effect is dominant whille at higher parities some of the biological effect is offset by the negative effect from the desire to stop childbearing.

The husband's being the eldest son has some positive effects in general although the effects are not significant, 5 percent level in most cases. Exceptions are a 21 percent positive effect among the 1985 cohort at first parity, a 14 percent positive effect among the 1980～1984 cohort at second parity, and a 35 percent positive effect among the 1975～1979 cohort at third parity.

This indicates changes in the family size preferences. That is, as people desire a smaller family, the husband's birth order has a significant effect at lower parities. Residence in a metropolitan area is not significant at all parities nor among all cohorts. The age at previous pregnancy is included as a control for the biological fecundability difference by age. The risk of

7) The study by Bumpass et al.(1986) showed similar results. Using the 1974 Korean National Fertility Survey, they showed that the conditional probability of a birth is much higher during the early period of the second birth interval for women with 12 or more years of education than for those with no education

pregnancy shows a declining trend with age with the maximum in the early 20s for the first parity and in the mid or late 20s for higher parities.

B. Determinants of Pregnancy Outcome

The logistic regression model is appropriate where the dependent variable is dichotomous. The outcome of the pregnancy is defined to be the value of one if it ends with an abortion and zero if it ends in a live birth. Since the coefficients are not directly interpretable, marginal effects are calculated at the mean values of covariates for discussion convenience. The outcome of pregnancy is estimated separately for each parity and by the year of pregnancy. The estimation results are presented in Tables 5.1 through 5.4

Table 5.1–5.4 Logit Estimates of Pregnancy Outcome (Live birth=0: Abortion=1)

(5.1) First Pregnancy(marginal probability effect in parenthesis)

Covariates	Year of pregnancy			
	~1974	1975~'79	1980~'84	1985~
Intercept	1.21	1.14	2.99*	1.89*
Primary	reference (relative risk=1.00)			
Middle sch.	0.58* (0.05)	-0.07 (-0.01)	0.21 (0.03)	-0.83*(-0.15)
High sch.	0.68* (0.06)	-0.03 (0.00)	0.28 (0.04)	-0.56*(-0.10)
College+	0.76* (0.06)	-0.09 (-0.01)	0.52 (0.08)	-0.82*(-0.15)
Eldest(husb)	-0.16 (-0.01)	-0.02 (0.02)	-0.02 (-0.00)	-0.13 (-0.02)
Metro=1	0.47* (0.04)	0.25 (0.03)	0.36* (0.05)	0.37* (0.07)
Age	-0.27 (-0.02)	-0.24 (-0.03)	-0.46*(-0.07)	-0.27*(-0.05)
Age-sq	0.00 (0.001)	0.005 (0.002)	0.01*(0.002)	0.006 (0.004)
Log-likelihood	-715	-577	-778	-922
Model Chi-sq.	43	8.3	23	46
Total Number	2,256	1,376	1,662	1,675
Proportion aborted	0.10	0.15	0.18	0.25

* : Significant at 0.05 level.

(5.2) First Parity(marginal probability effect in parenthesis)

Covariates	Year of pregnancy			
	~1974	1975~'79	1980~'84	1985~
Intercept	-2.56	1.87	5.10*	3.90*
No son		reference (relative risk=1.00)		
One son	0.27* (0.04)	0.40* (0.08)	0.36* (0.08)	0.36* (0.09)
Primary		reference (relative risk=1.00)		
Middle sch.	0.40* (0.05)	0.32* (0.06)	0.22 (0.05)	0.01 (0.00)
High sch.	0.89* (0.12)	0.71* (0.14)	0.27* (0.07)	3.35* (0.09)
College+	1.45* (0.20)	0.64* (0.12)	0.44* (0.10)	0.18 (0.04)
Eldest(husb)	-0.18 (-0.02)	-0.12*(-0.02)	-0.14 (-0.03)	-0.26*(-0.07)
Metro=1	0.16 (0.02)	0.36* (0.07)	0.33* (0.07)	0.19* (0.05)
Age	0.06 (0.01)	-0.27 (-0.05)	-0.58*(-0.13)	-0.50*(-0.12)
Age-sq	-0.002 (0.00)	0.00 (0.00)	0.01* (0.00)	0.01* (0.00)
Log-likelihood	-871	-935	-1,253	-1,670
Model Chi-sq.	72	59	61	83
Total Number	1,983	1,662	2,010	2,481
Proportion aborted	0.17	0.27	0.34	0.46

* : Significant at 0.05 level.

(5.3) Second Parity(marginal probability effect in parenthesis)

Covariates	Year of pregnancy			
	~1974	1975~'79	1980~'84	1985~
Intercept	-12.7*	6.16	9.10*	1.14
No son		reference (relative risk=1.00)		
One son	0.69* (0.14)	1.20* (0.30)	1.19* (0.25)	1.93* (0.23)
Two sons	0.91* (0.19)	1.67* (0.42)	1.60* (0.34)	2.23* (0.27)
Primary		reference (relative risk=1.00)		
Middle sch.	0.66* (0.14)	0.71* (0.18)	0.82* (0.17)	0.77* (0.09)
High sch.	0.94* (0.19)	1.05* (0.26)	1.20* (0.25)	0.82* (0.10)
College+	1.35* (0.28)	0.74* (0.18)	1.10* (0.23)	1.04* (0.12)
Eldest(husb)	-0.01 (0.00)	-0.30*(-0.08)	-0.22 (-0.05)	-0.23 (-0.03)
Metro=1	0.75* (0.15)	0.42* (0.10)	0.53* (0.11)	0.63* (0.08)
Age	0.78* (0.16)	-0.58*(-0.14)	-0.82*(-0.17)	-0.16 (-0.02)
Age-sq	-0.01* (0.00)	0.01* (0.00)	0.02* (0.00)	0.00 (0.00)
Log-likelihood	-743	-867	-864	-512
Model Chi-sq.	143	197	214	200
Total Number	1,311	1,393	1,534	1,276
Proportion aborted	0.31	0.47	0.67	0.81

* : Significant at 0.05 level.

(5.4) Third Parity(marginal probability effect in parenthesis)

Covariates	Year of pregnancy			
	~1974	1975~'79	1980~'84	1985~
Intercept	-4.62	-3.49	6.43	-5.00
No son		reference (relative risk=1.00)		
One son	0.55* (0.14)	0.78* (0.17)	1.27* (0.21)	1.25* (0.15)
Two sons	1.59* (0.39)	1.88* (0.42)	2.08* (0.34)	1.72* (0.21)
Primary		reference (relative risk=1.00)		
Middle sch.	1.00* (0.25)	0.77* (0.17)	0.78* (0.13)	0.99* (0.12)
High sch.	0.99* (0.24)	0.49* (0.11)	0.68* (0.11)	0.67 (0.08)
College+	0.93 (0.23)	1.12* (0.25)	1.44* (0.23)	0.56 (0.07)
Eldest(husb)	-0.40* (0.10)	-0.27*(-0.06)	-0.22 (-0.04)	-0.36 (-0.04)
Metro=1	0.65* (0.16)	0.78* (0.17)	0.83* (0.14)	0.68 (0.08)
Age	0.15 (0.04)	0.13 (0.03)	-0.57 (-0.09)	0.33 (0.04)
Age-sq	0.00 (0.00)	0.01 (0.00)	0.01* (0.00)	-0.00 (0.00)
Log-likelihood	-453	-721	-496	-169
Model Chi-sq.	132	196	165	73
Total Number	753	1,258	1,040	414
Proportion aborted	0.46	0.65	0.76	0.81

* : Significant at 0.05 level.

APPENDIX: Relative risk of Birth

(1) Frist Parity

Covariates	Year of the previous birth			
	~1974	1975~'79	1980~'84	1985~
No son		reference (relative risk=1.00)		
One son	0.85 (3.60)	0.87 (2.50)	0.81 (3.85)	0.69 (5.24)
Primary		reference (relative risk=1.00)		
Middle sch.	0.96 (0.70)	1.01 (0.18)	0.92 (0.90)	1.21 (1.17)
High sch.	0.89 (1.87)	0.89 (1.49)	0.86 (1.86)	1.04 (0.23)
College+	0.90 (0.85)	0.91 (0.69)	0.99 (0.05)	0.91 (0.50)
Eldest(husb)	1.00 (0.04)	1.12 (2.06)	1.04 (0.69)	1.34 (4.04)
Metro=1	1.00 (0.05)	0.94 (1.07)	0.83 (3.38)	0.92 (1.08)
Age at previous birth(Apb)	1.25 (5.23)	1.26 (4.39)	1.19 (3.33)	1.30 (3.51)
Apb-sq	0.99 (5.05)	0.99 (4.86)	0.99 (4.31)	0.99 (4.01)
Log-likelihood	-13,442	-7,776	-9,225	-5,471
Model Chi-sq.	44	48	80	81
Total Number	2,054	1,298	1,619	1,678

(2) Second Parity

Covariates	Year of the second birth			
	~1974	1975~'79	1980~'84	1985~
No son		reference (relative risk=1.00)		
One son	0.69 (5.30)	0.41 (10.3)	0.30 (10.4)	0.12 (9.04)
Two sons	0.53 (7.67)	0.25 (12.1)	0.17 (10.1)	0.16 (6.59)
Primary		reference (relative risk=1.00)		
Middle sch.	0.73 (4.09)	0.70 (3.89)	0.54 (4.65)	0.69 (1.31)
High sch.	0.61 (5.42)	0.67 (6.06)	0.46 (5.48)	0.57 (2.09)
College+	0.64 (2.23)	0.60 (2.58)	0.49 (2.80)	0.51 (1.62)
Eldest(husb)	0.96 (0.69)	1.19 (2.17)	1.21 (1.79)	1.28 (1.36)
Metro=1	0.78 (3.94)	0.71 (4.05)	0.66 (3.56)	0.64 (2.38)
Age at previous birth(Apb)	1.19 (2.61)	1.19 (2.51)	0.97 (0.35)	1.10 (0.50)
Apb-sq	0.99 (3.26)	0.99 (3.56)	1.00 (0.17)	1.00 (0.75)
Log-likelihood	-7,757	-4,273	-2,344	-772
Model Chi-sq.	174	284	223	132
Total Number	1,432	1,164	1,339	1,333

(3) Third Parity

Covariates	Year of the third birth			
	~1974	1975~'79	1980~'84	1985~
No son		reference (relative risk=1.00)		
One son	0.58 (4.22)	0.41 (6.20)	0.21 (6.83)	0.13 (4.53)
Two sons	0.27 (9.94)	0.18 (10.5)	0.10 (7.78)	0.26 (2.70)
Primary		reference (relative risk=1.00)		
Middle sch.	0.71 (2.61)	0.61 (3.15)	0.49 (2.76)	0.51 (1.33)
High sch.	0.58 (3.18)	0.77 (1.43)	0.61 (1.90)	0.46 (1.56)
College+	0.65 (1.08)	0.38 (2.12)	0.34 (1.48)	1.40 (0.42)
Eldest(husb)	1.26 (2.48)	1.52 (3.37)	1.75 (2.66)	1.07 (0.18)
Metro=1	0.58 (5.11)	0.65 (3.12)	0.73 (1.33)	0.36 (1.82)
Age at previous birth(Apb)	1.08 (0.60)	1.06 (0.42)	0.92 (0.39)	0.84 (0.78)
Apb-sq	0.99 (1.38)	0.99 (0.99)	0.99 (0.05)	1.00 (0.34)
Log-likelihood	-2,999	-1,649	-554	-134
Model Chi-sq.	206	175	103	418
Total Number	794	694	564	252

1. Sex of Existing Children

At all parities the sex of existing children is an important factor in the subsequent pregnancy outcome. At the first parity (Table 5.2), a son increases the abortion probability by 4 percent for the earliest cohort, but it grows to 9 percent for the most recent chort. Again, this is an indication of the changing preference for smaller families. The effects are much greater at the second and third parities, and they remain substantial at all cohorts. For example, the abortion probability for parents with two boys are 20 to 40 percent higher than for those without a son, but the difference has been decreasing. For example, at the third parity families with two or more sons among the earliest cohort are 25 percent more likely to end a subsequent pregnancy by abortion than those with only one son, while the difference is only 6 percent for the most recent cohort.

2. Education

The abortion probability for a first pregnancy with conception before 1975 is 5−6 percent higher as the woman's education increases from primary to a higher level. This effect disappears for first pregnancies conceived during the period between 1975 and 1984. The effect returns after 1984 but the sign turns negative. Higher than primary level education reduces abortion probability by 10 to 15 percent. Since an aborted first pregnancy is usually a premarital pregnancy, this reversal of the education effect indicates the higher likelihood of premarital pregnancy for women with primary or lower education than for those among the recent cohorts with a higher education.

A woman's education has significant positive effects on the probability of abortion in pregnancies at the parities beyond zero. The effect is particularly great for the early cohorts. For pregnancies with conception before 1975, education above primary level raises the abortion probability by 13 percent at first parity and by more than 20 percent at second or third parity. the magnitude of the effect has been going down at all parities. For the most recent cohort, it is about 5 percent at first parity and 10 percent at second and third parities.

In conclusion, education has almost no erffect on the rate of subsequent pregnancies and, when it does, the effect is often positive, but it has some positive effects on the probability of a pregnancy is ending by abortion. The higher abortion rate among better educated women indicates that they wish to end childbearing earlier or lengthen birth intervals compared to less educated women, but they do not necessarily use more effective contraceptive methods than less educated women. In fact, the proportion who accepted a surgical sterilization operation is much higher among less educated women. For example, among women with two children, about 63 percent of those with less than high school educations were surgically sterilized while only 47 percent of college educated women were. Better educated women instead rely more often on the less effective methods, such as the condom or the rhythm method, resulting in a higher risk of unwanted pregnancies. This seems to be the cause of the higher abortion probability among better educated women. Although the question of why better educated women use less effective methods is an interesting issue, but it is outside the scope of this study.

3. Other Controls

The husband's being the eldest son increases the chance of a live birth by about 6 percent among the most recent cohort, and residence in a metropolitan area gives about a 10 percent higher chance of abortion on the average. This seems to indicate the higher opportunity costs of carrying and raising children and easier access to a facility where abortion can be performed in metropolitan areas. The interaction terms of sex composition with education and the place of residence all proved to be insignificant.

4. Birth Intervals

Finally, we discuss briefly the results of the proportional hazards estimation of birth intervals, the estimation results shown in the appendix, compared with pregnancy intervals. A brith interval is essentially a combined result of a pregnancy interval and the pregnancy outcome. By this decomposition of birth intervals we gain additional insight in to the complex nature of fertility. As shown in the previous two section, the determinants of pregnancy risks are often different from those of pregnancy outcome. The effect of the sex of previous children is much greater for birth intervals than for pregnancy intervals due to the different abortion rates by sex composition. The contribution of abortions to the determination of birth intervals has increased over time.

An important finding is that, mostly because of higher abortion rates not lower pregnancy risks, a woman's education has a considerable negative effect on birth risk, especially at the second and third parities. In some cases education effects on pregnancy risks are positive while they are negative on birth risks. the same is true with the place of residence. While pregnancy risks do not differ much by place of residence, birth risks are much smaller in urban areas due to more frequent abortions.

VI. Summary and Conclusions

Within the short span of a quarter century, Korea has completed a demographic transition from high to low fertility and mortality. During the period of 1960 to 1987, TFR declined by 73 percent from 6.0 to 1.6, which was much faster than in the other developing countries at a similar stage of fertility transition. The rapid decline of fertility in Korea has been accelerated by the interaction effects of the successful implementation of its Five-Year Economic Development Plans and its population control policies since 1962. The main purpose of this study is, therefore, to examine the determinants of fertility and their changes over time in Korea. The analysis is divided into two parts. First, the timing of the first pregnancy and the pace of subsequent pregnancies are estimated by the proportional hazards mode. Second, a logistic regression model is used to estimate the determinants of how each pregnancy ends. This decomposition yields additional insights on the complex nature of fertility. In both analyses the sex composition of existing children and the woman's education are included as the main explanatory variables.

The timing or wife's age at first pregnancy is most affected by the woman's education. Particularly, college educated women show a substantial delay in their first pregnancy. On the other hand, the outcome of the first pregnancy does not show much difference by education or by the place of residence among all cohorts. Beyond the first pregnancy, the sex of existing children stands out as the most important factor in deciding the pace of pregnancy and its outcome at all time periods. The presence of a son reduces pregnancy risks by almost one-half at the second and third parities. The probability of a pregnancy ending in abortion also increases substantially when there is a male child. As the desired family size has declined over time, the son prference has become a more important determinant of fertility.

Surprisingly, a woman's education did not show any consistent effect on the second or higher pregnancy intervals. The effective family planning programs which went into effect throughout the country with heavier emphasis on rural areas and areas where the education level was low may be responsible for this. the current use of any contraceptive method computed from the data used in this study shows very similar percentages across education groups at all parities. On the other hand, the outcome of pregnancy is very much affected by the woman's educational level. At all parities except for the first pregnancy, better educated women are substantially more likely to end their pregnancies by abortion although the difference has been narrowed in recent year. The difference in fertility by education is mostly due to the delay of the first pregnancy and the more often practiced abortions among educated women.

Given the small family size desired across education groups, even the education difference in the age at marriage is not likely to affect fertility in any significant manner. One the other hand, the sex composition of existing children has become the most important variable in determining both the pace and the outcome of pregnancy at all parities. Most young parents want to stop their childbearing at one or two children, and much more so if the first or second child is a son. The preference for small family size is often in conflict with the desire to secure a son. The recent availability of a medical screening test for fetal gender has enabled many parents to secure a son within the desired family size through gender-selective abortion. This has led to a biased sex ratio at birth in Korea in recent years, and has added a new dimension to the problem of fertility. A more complete model is needed to consider these multiple stages (pregnancy, screening test of fetal gender, and abortion) involved in the problem.

Korea has achieved a remarkable decline in fertility during the last three decades, and its family planning programs have been important contributors, but the programs often emphasized quantity and ignored the quality aspect of family planning. The legal and social attitude toward abortion has been exceptionally generous and abortion has been commonly used method to control fertility. Increasing premarital and teen pregnancies are likely to worsen the situation in the future. Furthermore, genderselective abortions have been increasing rapidly in recent year. The potential problems arising from a biased sex ratio could be seriously harmful, and so should be addressed immediately by rese-archers as well as policy makers. Although son preference would not be easily abandoned, improvement in social security for the elderly could diminish the financial motivation for sons, or legal and social provisions which enhance women's status may also work favorabley. the importance of family planning should not be underrated just because of the low fertility rate. It is about time that the government or other interest groups paid more attentions to the enhancement of the quality of family planning, such as preventing unwanted pregnancies by increasing the use of more effective contraceptive methods, or establishing more effective regulations to prohibit selective abortions. Furture family planning programs should be fully integrated with public health programs and, in particular, with maternal and child health services for the improvement of population quality.

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《국문초록》

우리나라의 出産力 變動要因에 관한 分析

－ 姙娠間隔과 結果를 中心으로 －

趙南勳* · 安南基**

우리나라는 1962년 이래 정부 가족계획사업의 성공적인 수행으로 인구전환의 전과정을 완료하였으며, 이와 같은 성과는 그간의 사회·경제적 발전과 병행하여 이룩되었다. 그간의 출산력 저하는 주로 초혼연령의 상승과 유배우 출산율의 저하에 기인된 것이며 유배우 출산율의 감소는 인공임신중절을 포함한 정부 가족계획사업의 성과에 기인된 것이다.

따라서 본 연구는 향후 인구억제정책의 추진방향을 제시하기 위한 목적으로 출산율 변동요인의 시계열적 변화를 분석하는데 초점을 두었다. 본 분석에서는 비례위험모형(Proportional Hazards Model)을 적용한 임신간격의 추정과 「로지스틱」 회귀분석 모형을 이용하여 임신결과에 성구성 및 부인의 교육이 주요 설명변수로 포함되었으며, 부인의 교육은 첫번째 임신시기(부인의 연령)을 연장하는데 상당한 영향을 미쳤으나 후속 임신속도에 미치는 영향은 점차 감소되고 있다.

반면에 부인의 교육은 임신이 인공임신중절로 귀결하는데 일관성 있게 정(正)의 효과를 나타내고 있으나 이 효과는 시간이 경과함에 따라 감소하는 경향을 보이고 있다. 첫번째 출산에서 현존자녀의 성(性)은 임신의 속도와 임신 결과를 결정하는데 가장 중요한 요인으로 나타났다. 아들을 둔 부인의 임신위험은 두번째 및 세번째 출산에서 거의 반감되었고, 한아들을 둔 부모인 경우 임신이 인공임신중절로 귀결되는 빈도가 증가되고 있다. 결론적으로 우리나라의 경우 출산력은 급격히 저하되었으나 아직도 상존하고 있는 강력한 남아선호로 인하여 자녀의 성이 출산력 변동에 미치는 요인으로서 그 중요성이 더욱 점증되고 있는 반면에, 부인의 교육은 그 영향도가 반감되고 있음을 보이고 있다. 따라서 향후의 인구억제정책은 남아호선관의 불식으로 성비의 균형을 유지하고 인공임신중절율을 감소시키는데 역점을 두어야 할 것이다.

* 한국보건사회연구원 연구위원

** 한국보건사회연구원 초빙연구원