THE INFLUENCE OF WOMEN'S STATUS ON FERTILITY BEHAVIOR BETWEEN TAIWAN AND CHINA—A MULTILEVEL ANALYSIS

A Dissertation

by

JIN-KAI GODFREY LI

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2005

Major Subject: Sociology

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Approved as to style and content by:

Dudley L. Poston (Chair of Committee)	Barbara Finlay (Member)
Mark Fossett (Member)	Don E. Albrecht (Member)
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ABSTRACT

The Influence of Women's Status on Fertility Behavior Between Taiwan and China—A Multilevel Analysis. (May 2005)

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Since 1949 Taiwan and China have been governed by different political regimes. Nevertheless, after more than fifty years, research shows that women in both societies now enjoy significantly higher social status and have lower fertility rates. Despite well-documented literature on the relationship between fertility and women's status in Taiwan and China, no systematic empirical research has compared the two. This dissertation was designed to investigate the effects of women's status on fertility and sterilization behaviors in China and Taiwan by means of multi-level analysis focusing on women's education levels and employment status as predictors at both the individual and aggregate levels. To examine the influence of enforced policy, in China's models, variables were added about whether the participants had a government-issued one-child certificate or had complied with the childbirth quota set by local authorities.

Most results are consistent with our hypotheses. At the macro level, female college graduation rate is significant in Taiwan but not in China. One-child certificate rate is significantly correlated with provincial-level number of Child Ever Born (CEB). At the micro level of Poisson and logistic models, women with status are significantly more likely to have smaller numbers of CEB and lower sterilization usage. Survival analysis that simultaneously analyzed time duration and event occurrence showed dynamic effects of women's status on the probability of a first, second and third childbirth.

The Hierarchical Generalized Linear Models (HGLM) method shows both some direct and some interactive effects of contextual variables on fertility and contraceptive behaviors. In both countries, wives' educational levels showed the greatest numbers of significant correlations with the dependent variables. Both Western socioeconomically based demographic transition theory and Asian planned demographic transition theory in China receive empirical support in the findings.

Methodological and policy implications for future studies are discussed. The findings of this dissertation, particularly the micro-macro linkages, contribute to an explanation of how higher women's status and lower fertility rates across the two regimes emerged from both common and disparate processes. This dissertation also illustrates how multi-level investigations of fertility and women's status could be implemented in other parts of the world.

ACKNOWLEDGEMENTS

There is one person above all others who deserves my deepest thanks and respect for his continued support during the writing of this dissertation, my advisor, Dr. Dudley L. Poston. I could not have done it without him. I appreciate his detailed comments and suggestions on this and other work, and his support and advice in other areas of academic life. He fostered a stress-free working relationship which was crucial to the completion of this work.

My wife, Pi-chu Chuang, has been a source of strength and support throughout my graduate studies in the USA. She has assumed the main burden of taking care of our two lovely children, Phila, seven-year-old daughter, and James, our three-and-half-year-old son, allowing me to focus on the writing of this dissertation.

I am also grateful to the members of my committee, Dr. Barbara Finlay, Dr. Mark Fossett, and Dr. Don E Albrecht. Thanks to them for their support and suggestions. In particular, thanks to Dr. Finlay who was on academic leave, but who was willing to participate in the oral defense by conference phone.

I am grateful to the Taiwan Family Planning Center for providing the 1992 Knowledge, Attitude, and Practice (KAP) survey of family planning among married women. In addition, thanks to my friends, Dr. and Mrs. Suh, for their concern and support with the progress of my dissertation.

Finally, I would like to thank my parents, Mr. Kuo-nen Lee and Mrs. May-rong Chen Lee, for their support and care over the years.

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CHAPTER I

INTRODUCTION

Throughout most of the world, women do not have equal status with men. Compared with men, women have very limited opportunities in most spheres of economic and social activity (Sadik 1984). Further, a close relationship has been observed between various aspects of women's status in society and concomitant demographic patterns of fertility, mortality and migration. This observed correlation has been shown to be especially prominent with regard to fertility and its associated social consequences (United Nations 1975). It has long been argued that the low status of women--including subordination to the control of males and exclusion from access to various societal resources and income-generating opportunities--is an important obstacle to demographic modernization. Improvements in the social status of women are often depicted as preconditions to the achievement of lower mortality and fertility rates.

Historically, the position of women in China has been connected to the structure of the family. As a consequence of patriarchal familial values, inequality between men and women has long been securely institutionalized in Chinese society. For example, women have been forbidden to hold religious office, to own property, and even to have their names written in the ancestral books. Women's subordination in the family has lasted for centuries. Their social status has been dictated by norms that they devote themselves to the needs of their families. Both single and married women were

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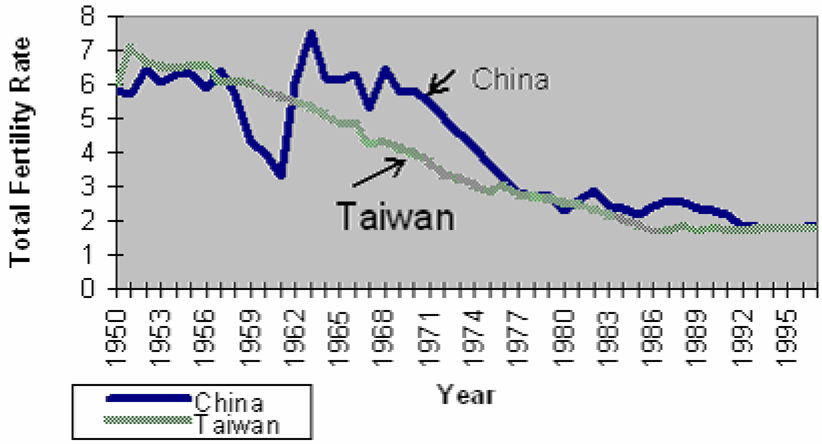
The style used in this dissertation is that of the *American Journal of Sociology*.

subjected to countless constraining expectations. Women were expected to reproduce male offspring, to perform virtually all household chores, and to obey their in-laws. Their lives were constrained by obedience, forbearance and tolerance, and suffered from the polygamous marriages of their husbands. For disobedience to their husbands or their in-laws, they could be banished from their families. As victims of social tradition, women had only one means to improve their social status: giving birth to male offspring.

Since 1949 when the civil war ended between the Capitalist Kuomintang Party and the Communist Party, Taiwan (Republic of China, ROC) and China (People Republic of China, PRC) have been separately ruled by different regimes. After more than fifty years, currently there are few differences in women's status between those two areas. Although research shows that both sides have made progress in women's status, immense room for improvement remains. Most of the traditional restrictions on women are no longer present. Women’s equal rights have been declared and are protected by laws in both regimes (State Council Press Office. 1994a). In 1985, China’s 70 percent employment rate for women was the highest in the world, and there is evidence this contributed to greater equality in attitudes about marital roles, whether or not actual changes occurred in marital-role behaviors (Farris 2000). Tuan (1989) opines that only a revolution can bring about such extensive and rapid changes for Chinese women because almost all women of working age are employed; this high rate of employment, Tuan surmises, may be due in part to the extensive use of contraception. Phan (1997) attributes the reasons for declining fertility in the PRC to improvement in the social status of women since 1949 and to improvement in educational opportunities--particularly for women--plus economic development.

In Taiwan, women's enhanced status is seen in rising educational levels, increased participation in the work force, enhanced legal rights, and expanded control over life decisions such as how to spend one's wages, whom to marry, where to live, and how many children to bear. In Taiwan, Chiang (1990) acknowledges the historical improvement in the status of women since the 1950s in spite of many impediments to change. Fricke and associates (1994) examined the period between marriage and first childbearing and found that the experience of work outside the home was associated with a fivefold increase in the duration of that period across the cohorts from 1955-1984. They also found a fourfold increase in the period between the birth of a first and second child.

Levels of fertility and women's status are related, because a woman's frequent pregnancy and child rearing necessarily confine her to the home and prevent her socializing outside the home. Such confinement can cause qualitative changes in lifestyle, values, level of aspiration, motivation, degree of modernization, and access to potential roles. Those resultant constraints tend to diminish the status of women and their quality of life. Poston (1998) states that Taiwan and China have encountered dramatic reductions in their fertility rates in the past forty years, from total fertility rates (TFRs) of greater than six in the early 1950's to TFRs in the late 1990s of less than two (Figure 1.1). Conspicuously, both countries began and ended their fertility transitions at almost the exact same times and levels.



Source: Poston (1998)

Figure 1.1 Total Fertility Rates: China and Taiwan, 1950-1997

In the social sciences, research targets are often conceptually hierarchical. In other words, the dependent variables of individual characteristics are grouped into larger units and contexts, such as schools, neighborhoods, cities, and so forth. If the theories hypothesize that the behaviors of interest will be influenced by both the person's characteristics and those of the context, then the independent variables we would be interested in should refer to the characteristics of both the individuals and the higher order units (de Leeuw 1992, p. xiii). Contextual studies investigate the relationship between social structure and individuals, a major concern of sociology (Huber 1991). The original and most famous of these studies is Emile Durkheim's classic study *Suicide* (1951), in which he concluded that the reason people commit suicide cannot totally be attributed to their own psychological factors. DiPrete and Forristal argue:

"The idea that individuals respond to the social context is a defining claim of the sociological discipline, which is found in Marx's work on political economy, in Durkheim's studies of the impact of community on anomie and suicide, in Weber's research on how the religious community shapes economic behavior, in Merton's work on communities, relative deprivation, and social comparison theory, and in Berelson and his colleagues' research on the effect of social context on voting" (1994, p. 331).

Work in this area has been done by political scientists analyzing the contextual effect of neighborhoods on voting behavior; well known classics are Huckfeldt (1986), Lazarsfeld, Berelson and Gaudet (1944), and Lipset (1963). Huckfeldt (1986) defines contextual effect as "instances in which individual behavior is affected by the presence of a social property in a population regardless of whether the individual possesses the property in question" (p. 5).

Freedman (1974) suggested that in demographic studies, researchers should go beyond the characteristics of individuals in order to understand fertility behavior and should analyze fertility decisions within the social context (the community characteristics) in which the individual lives. Besides research on how characteristics of villages affect fertility behavior (Entwisle et al. 1984, 1996, 1997), Mason, Wong and Entwisle (1983) examined how differences in socioeconomic development and family planning across fifteen developing countries influenced and interacted with the individual-level relationship between women's educational attainment and the number of children born. Since the social and economic characteristics of an area influence the degree to which women perceive, approve and achieve the goal of having a small family

(Rosen and LaRaia 1972), an important question is whether community characteristics that identify the individual's normative environment may intensify or hamper the microrelationship between fertility and education.

In this dissertation, I will examine the effects of variables at the aggregate level on the relationship between individual characteristics and women's fertility behaviors. I will principally use multilevel contextual analysis to address those concerns. Education and employment status are the main indicators of women's status. The focus is on the aggregate effect of women's status in Chinese provinces and Taiwanese counties on women's fertility behavior, as well as the interactive effects of those macro-level variables with individual variables. In addition, I will look at the micro-level to determine whether individual women's working status and education level affect their fertility activities under controlling macro variables.

The fertility outcomes analyzed here are children ever born (CEB), sterilization usage, the duration between marriage and first birth, the duration between first child and second birth, and the duration between second child and third birth. First, Poisson models for CEB, logistic models for sterilization usage, and survival analysis for the three durations will be estimated for individual women. Then, the macro-level CEB and sterilization rate will be regressed with the macro-level women's status. In order to understand the degree to which individual effects, contextual effects and their interactive influences have an impact on fertility, the dependent variables of CEB and sterilization status will be analyzed by Hierarchical Generalized Linear Models (HGLM). Individual data are from the *1992 Seventh KAP (Knowledge, Attitude, and Practice of*

Contraception) Survey for Taiwan (TPIFP 1992) and the *1988 China Woman Fertility Survey* (SFPCC 1989) for China. Macro-level data are from the *Taiwan-Fukien Demographic Fact Book 1992* (EYRC 1992)for Taiwan and the *1990 China Population Census* (NBSC 1991) for China.

The purposes of this dissertation are distinctive in several ways from previous research. First, regarding the relationship between fertility behavior and women's status, the focus here is on the interaction of contextual effects, family structure and personal characteristics. Unlike conventional studies, advanced multilevel analysis methods can efficiently assist in the construction of models that simultaneously incorporate the effects on the outcome, inclusively, of level-one and level-two characteristics. Accordingly, a clearer picture may emerge of how individual women may be shaping their fertility decisions based on the contextual effects of greater or lesser status of women in the society. Second, although individual level women's status indexes of education and employment at the individual level have been shown to be important predictors of fertility patterns, many questions remain unanswered about the dynamics of those effects. In this study, several methods (Poisson, logistic analysis, survival analysis, and multilevel estimation) will be employed to provide a broader empirical base from which to clarify the correlation of these indexes with fertility decline. Third, some previous research has focused on differences and similarities of the fertility transition in different geographic areas (Coale and Freedman 1993; Poston 1998). Directly comparing China and Taiwan in respect to fertility behavior and women's status is not common, however, and this study attempts to look at the influence of women's status on fertility to discover whether women's status could be a good predictor of fertility on both sides of the Taiwan Strait.

To achieve those goals, the dissertation consists of seven chapters. Following this introduction, Chapter II reviews the literature on women's status in China and Taiwan in terms of employment status, economic gains, family status, educational achievement, and political involvement. It ends with a brief comparison of women's status in both regimes. Chapter III describes the demographic transition of China and Taiwan, especially the role of family planning programs, across those two regions. Chapter IV discusses the theoretical background of the relationship between fertility and women's status and primarily focuses on the main indicators of women's status: education and employment. The chapter also discusses influences of family structure on fertility behavior, and the feminization of sterilization is illustrated for both territories. Chapter V consists of data sources, variable lists, basic descriptions of macro and micro variables, hypotheses, and statistical methods. Chapter VI introduces robust regression models to examine the effects of contextual variables on fertility behaviors for the 29 provinces of China and the 23 counties of Taiwan. Poisson models are used to explore micro-level variable effects on children ever born. Sterilization status is analyzed with logistic regression. The dependent variables (1) macro-level CEB and (2) sterilization rate are regressed on the macro-level women's status indexes. Then, the survival analysis is introduced to investigate individual variables on the hazard rate of childbirth from the first to the third childbirth. Lastly, multilevel models are used to examine the interactive effects of micro-level and macro-level variables in HGLM models for fertility and sterilization. The final chapter, Chapter VII, summarizes the findings and provides suggestions for future research.

The limitations of this dissertation are worth mentioning. The differences in fertility and women's status between rural and urban areas should be carefully controlled, especially in China. The 1988 data from China, however, do not offer such information. The proxy variable that is substituted is the ratio of agricultural workers; the discrepancy between rural and urban areas in opportunities for employment arguably influences how women respond in their fertility behaviors. The data of both regimes also fail to provide detailed specification of job categories. Despite all these limitations and constraints, the findings should contribute important information to the literature on women’s status and fertility.

CHAPTER II

WOMEN'S STATUS IN CHINA AND TAIWAN

Women's Status in China

Like women in other parts of the world, Chinese women traditionally have experienced oppressive gender discrimination for many generations. For many generations, girls were regarded as inferior to boys. The old Chinese ideas of yin (female) and yang (male) highlighted the social hierarchy of men and women. Yang referred to good fortune and all that was desirable, while yin referred to the elements of dark and evil. Females were viewed as subordinate to males, an ornament to the males' social spectrum. In Mao Zedong's report on an investigation of the peasant movement in Hunan (Mao 1967), he noted that "men in China are usually subjected to the domination of three systems of authority: political authority, clan authority, and religious authority. As for women, in addition to being dominated by these three systems of authority, they are also dominated by men, mainly by the authority of their husbands" (Mao 1967, p. 28). This discriminatory perception is reflected in a widely known Chinese proverb, "A girl without intelligence and talent is one of integrity."

The traditional concept of the "three obediences" also can account for this kind of subservience. When a girl lives in the parental home, she must obey her father; when she is married, she must obey her husband; and when her husband dies, she must obey her son. Men had complete authority over women's labor, daily activities, use of resources, and even their life and death. According to the old Chinese saying, having daughters was like "spilling water on the ground." The female child will be married to her husband's house, she requires a dowry to be married, and she is devoted to serving her husband's family. Female infanticide was common. It is not difficult to understand why parents were not expected to allocate much of their resources to their daughters for education or other useful skills, given those pervasive societal values.

In the Chinese patrilineal and patriarchal culture, family membership and economic cooperation, inheritance of property, lines of authority, and surname-carrying were defined to an extraordinary extent by way of males. Marriages were handled by the parents through matchmakers. A young couple did not meet until the day of their wedding. Marrying well gave dignity and grace to a woman. A woman also acquired greater importance in the family through bearing a son. A woman without a son was stigmatized by family members and neighbors. Even as she grew older, she did not have honor and support (Latourette 1964).

The cruelest ancient custom regarding women was binding the feet of females. This notorious custom not only degraded women's health, but also restricted them from leaving the home and breaking away from their husband's dominance.

Since 1949, when the Chinese Communist party (CCP) defeated the ruling Nationalist party on the mainland, the People's Republic of China (PRC), based on Marxist principles, claimed to liberate the oppressed masses. Although national interests have always overridden gender interests in the PRC, its government opposed the system based on traditional sex roles and started to promote women's social and economic status. The first constitution proclaimed that the People's Republic of China shall eradicate the feudal system that impeded women. It declared that women shall enjoy equal rights with men in all spheres of life: political, economic, cultural and social, including family life. Men and women shall have the freedom to choose their own spouses. This espousal of gender equality has been reiterated in subsequent revisions of the constitution. The Marriage Law in 1950 gave the option of divorce for persons in arranged marriages, prohibited arranged marriage, bigamy, concubinage, child betrothal, and interference with the marriage of widows. At the same time, the Land Reform law assured women the ownership of land so as to have financial independence from their husbands. Rural women's status was greatly changed because women became independent laborers and household providers. In addition, collective labor enlarged rural women's vision and scope of information and gave them opportunities to be elected as model workers and subsequently promoted to administrative levels (Gao 1994). In 1953, the Electoral Law stipulated that women enjoy the same electoral rights as men. The All China Women's Federation (ACWF) established in 1949 by the CCP was charged with the dual responsibilities of implementing government policy on behalf of women and with bringing women's complaints to the various organizations within the Party. By 1953, offices of the Women's Federation had been set up in most of China's cities and counties, including some of the minority autonomous areas (Wang 1999).

Park (1992) points out that women's emancipation in China has been continuously constrained by ideological, historical and developmental factors. During the revolutionary period, peasant resistance reduced women's participation in the revolutionary process and led to their exclusion from most leadership positions.

Traditional sex-role attitudes continued to be brought to the economic arena, limiting women's employment, training and advancement opportunities (Andors 1983). Appeals to the importance of separate spheres for women and men become particularly strong in times of economic crisis.

Women's political and economic activities were obviously elevated by the collectivization policy during the Great Leap Forward (1958-1960) that required the mass labor participation of men and women in communes, street industry, and industrial management (Yao 1983). During the Great Proletarian Cultural Revolution of 1966-76, women's rights were highlighted, and women were exhorted to participate in politics and labor for the national benefit. "Women hold up half the heaven" was a favorite slogan of Mao. Under the slogan of "Anything a man can do, a woman can do also," men and women were viewed as unisex. During this period, the belief that women were the same as men was emphasized.

In 1995, the United Nations Development Program (UNDP) created a gender-related development index (GDI) which takes into account gender inequalities. The indicators used in the GDI are life expectancy, adult literacy, combined school enrollment ratios and real income. China's ranking in terms of GDI is 79th. Yet China ranked 111 on the UN human development index (HDI) with relatively low incomes per capita. So China has relatively small gender inequalities (Tan 1999). China's ranking on the gender empowerment measure (GEM) is 23rd (UNDP 1995).

Overall, the progress of women's economic gains is noteworthy. Statistics collected shortly after 1949 showed that women were only 7.5% of the total workforce

(Davin 1976; Qi 1986). By 1984, however, 36% of the country's labor force was female (NBSC, 1985). Moreover, women stepped into a variety of occupations and professions that had formerly been occupied only by men. Women became construction-equipment operators, truck drivers and train conductors, lathe operators, metal casters and ship repairers (Curtin 1975; Yao 1983). Women began to occupy the administrative ranks, gaining positions in communes, factories and even in local and state government (Davin 1976). The proportion of women in medicine and engineering quickly became higher in China than in the United States (Davin 1976). Wage differences between women and men declined as well. A major study in the cities of Beijing and Shaoxing (Wolf 1985) showed that the gender gap in wages decreased as new cohorts of workers entered the labor force. Hsieh and Burgess (1994) note that China is not only one of the leading societies regarding female workforce participation, but the earning differential between men and women workers is one of the smallest among industrialized societies.

In 1993, the proportion of women in technical positions working in business and institutions across China reached 36.8%. Women engineers and technicians constituted 35% of the national total (Wu 1997). In 1994, there were 174,000 higher-level women professionals in various areas, 17.3 percent of the national total. Intermediate-level women professionals, 1.695 million in number, made up 30.4 percent of the national total. Andors observes that "in comparison with the position of women in pre-1949 China, there have been tremendous and positive changes. From a traditional agrarian society in which women were commodities and where the predominant female roles were those of housewife and mother, Chinese women have emerged to play important roles in an increasingly diverse and sophisticated economy" (Andors 1983, p. 173).

It is generally agreed that the labor market operates under the principles of social divisions of labor and social hierarchies. In a hierarchical labor market, women's employment faces structural restrictions (Redclift and Sinclair 1991). This is called gender segregation. This gender segregation can be further classified as horizontal segregation (referring to the extent to which men and women are concentrated in different jobs and occupations) or vertical segregation (defined as differences in pay, skills, status and promotion prospects between men and women within occupations) (West 1996).

Despite the state’s efforts to eliminate gender segregation, it had not been entirely eliminated in China in the 1980s. Judging from statistics on ownership sectors and industries, women were far more likely than men to be found in collective-run rather than state-run enterprises. Figures in Table 2.1 for 1983 show that 50% of collective-run employees were women, compared with 32% in the state-run sector (NBSC 1984).

Industrial distributions of male and female employees obtained from the 10% sample of the 1982 census (Beijing Review 1984) indicate that there is gender segregation by industry as well. Men constitute 56.3% of the employed population, yet they are 79% of the employees in administration. The figures show that 43.7% of the total labor force is female, and 48% of the employees in the public health, physical culture and social welfare industry are women. In addition, women make up 46.3% of agricultural workers and 44.1% of manufacturing employees. Approximately 43% of those in the commerce, catering service, material supply, marketing and storage industries are female.

Segregation of women in employment brings in its wake a subordinate status for women both economically and socially. For example, the wage differences are clear between state-run and collective-run enterprises (see Table 2.1). In 1988, the average yearly earnings in the state-run sector were 1853 yuan compared with 1426 yuan in the local-run sector (Annual of Chinese Statistics 1989). In addition, persons in the former sector have better housing, a better health-care package, and a better pension system than do persons in the latter. In a 1996 urban household survey, Zhao (2002) confirms this apparent difference. A higher female-to-male worker ratio is found in collective enterprises. The higher proportion of male employees in state-run enterprises is one indicator of the unfavorable economic status of women.

In the late 1970s, reform in Chinese economy led to the decentralization and autonomy of industries, the appearance of private enterprise, and the elimination of the "iron rice bowl" (very secure jobs). Strong evidence suggests that wage differentials between men and women even worsened during the 1990s, after economic and market reforms. A 1999 study showed that Chinese women earned 0.501 of the male wage in 1991 and 0.418 in 1994 (Maurer-Fazio et al. 1999). Tan (1997) in *Women in Social Development* reports that, overall, women are twice as likely as men to be laid off due to a labor surplus. Croll notes that "women have constituted a high proportion of the new casual labor force, much of it migrant, contracted to produce electronics, textiles, clothing and automobile components for the export market" (1994, p. 123).

Table 2.1 Industry Distribution of Female Employees and Average Industry Wages:State-run and Local-run Enterprises, 1983. People's Republic of China.

Industry	State-Run		Local - Run	
	Percent Female	Ave. Yuan Per Year in Industry	Percent Female	Ave. Yuan Per Year in Industry
Manufacturing, Mining, Lumber	32.1	874	50.4	684
Building, Geological Prospecting	33.2	1,023	56.5	844
Agriculture, Animal Husbandry, Forestry, Fishing	35.2	713	47.7	555
Transportation, Communication	20.2	959	29.3	787
Commerce and Trade	37.8	764	59.9	616
Housing, Public Utilities	37.5	876	47.6	776
Scientific Research	34.7	986	44.4	757
Health, Education, Culture and Social Welfare	38.7	861	44.6	685
Finance, Insurance	35.4	820	23.2	688
Government	17.0	927	53.3	696
Total	32.1	865	50.4	698

Source: NBSC 1984. *Annual of Chinese Statistics,* 1983 Pp. 126—129

As men head to the cities for higher-paying jobs, labor-intensive, low-paid, agricultural work is gradually becoming feminized and regarded as a domestic chore (Kelkar and Wang 1997). Croll points to a survey conducted by the ACWF that reports 75 percent of employers preferred to hire men and sometimes required women candidates to pass employment examinations with scores 12 percent higher than their male counterparts (1997, p. 120). Hao and Zhou (1985) report similar discrimination against women in entrance requirements for higher education (tertiary institutions). Woo (1994) points out that in the 1980s, protective legislation, with its unusually detailed restrictions, is a form of "biologization" of women, and can be seen as part of an effort during an era of surplus labor to push women out of the work force.

Compared with the progress made in female employment, the number of women who have received higher education is low. The distribution of women who received basic education and higher education indicates that gender equality in education is inadequate, and gender inequality in educational opportunities is especially serious in China. This is true in spite of major campaigns initiated by the CCP in the 1950s and 1960s to eradicate illiteracy, as part of its commitment to emancipating the masses from oppression and ignorance. In the past, 90 percent of women were illiterate, very few received opportunities for higher education, and the idea of men being superior and women being inferior was prevalent in China's cultural traditions. Until 1949, girls were not included in the nation's educational system. By contrast, in 1992 the percentage of girls between seven and eleven attending school was 96.2 percent, and the percentage of girls in high school was 43.1 percent (State Council Press Office 1994b). The number of women enrolled in higher education has risen rapidly (see Table 2.2 and Table 2.3 for provincial comparisons). In 1993, there were 852,000 women undergraduate students attending the 1,065 universities and colleges in China, making up 33.6 percent of the

Table 2.2 The Number and Proportion of Female College Students in China 1947-88.

Year	Number (10 Thousand)	Proportion
1947	2.76	17.8
1948	-	-
1949	2.32	19.8
1950	2.94	21.2
1951	3.51	22.5
1952	4.54	23.4
1953	5.47	25.3
1954	6.77	26.3
1955	7.58	25.9
1956	10.04	24.6
1957	10.33	23.3
1958	15.37	23.3
1959	18.33	22.6
1960	23.56	24.5
1961	23.35	24.7
1962	21.03	25.3
1963	19.38	25.8
1964	17.63	25.7
1965	18.13	26.9
1966	-	-
1967	-	-
1969	-	-
1970	-	-
1971	-	-
1972	-	-
1973	9.65	30.8
1974	14.52	33.8
1975	16.33	32.6
1976	18.65	33.0
1977	18.16	29.0
1978	20.65	24.1
1979	24.57	24.1
1980	26.81	23.4
1981	31.24	24.4
1982	30.54	26.5
1983	32.49	26.9
1984	39.98	28.6
1985	51.06	30.0
1986	47.90	25.5
1987	64.70	33.0
1988	68.94	33.4

Source: Research Institute of All China Women's Federation. 1991. *Statistics on Chinese Women 1949-1989*, p. 168

Table 2.3 The Number and Proportion of Female College Students by Province 1947-1988.

Province	Number	Female Number	Percentage
Total	2065923	694731	33.63
Beijing	143546	53036	36.95
Tianjin	63071	22421	35.55
Hebei	73047	31609	43.27
Shanxi	49450	19945	40.33
Neimenggu	32634	13749	42.13
Liaoning	120510	46388	38.49
Jilin	72933	27719	38.01
Heilongjiang	78879	29396	37.27
Shanghai	128163	45272	35.32
Jiangsu	147705	42701	28.91
Zhejiang	60419	19502	32.28
Anhui	63139	15536	24.61
Fujian	57059	17946	31.45
Jiangxi	52152	11742	22.51
Shandong	101281	31027	30.63
Henan	79882	26400	33.05
Hubei	130048	34094	26.22
Hunan	87297	24325	27.86
Guangdong	97224	30203	31.07
Guangxi	37524	12061	32.14
Hainan	9133	2422	26.52
Sichuan	140760	45012	31.98
Guizhou	27264	9630	35.32
Yunnan	44985	16130	35.86
Shaanxi	97955	36746	37.51
Gansu	33039	10295	31.16
Qinghai	7012	2987	42.60
Ningxia	7673	2986	38.92
Xinjiang	30483	13451	44.13

Source: Research Institute of All China Women's Federation. 1991.*Statistics on Chinese Women 1949-1989*, p. 169

total student enrollment. In the same year, 600 women graduate students were studying for a master's degree, 26 percent of the total; and some 300 doctoral students were women, or 11 percent of the total. As in a pyramid, women students made up 11 percent of doctoral students, 26 percent master's degree students, and 33.6 percent of undergraduates.

Despite such impressive gains in educational placement, however, the evidence cannot be ignored that girls face greater difficulties gaining access to schooling. Increasing dropout rates among school girls, especially in rural areas, may be tied to the need for a labor force to replace males who have migrated to cities. Over 71 percent of China's 164 million illiterates are women (SSSB 1997, p. 77), and 80 percent of the nearly 3 million unschooled primary-age children are girls (Rai 1993). Huge differences exist between urban areas and the distant poor rural areas; only 11 percent of Beijing were designated as illiterate or semi-literate women, but 69 percent of Tibetan women and 45 percent of Guizhou women were so classified.

For centuries, the traditional Chinese family has been basically patrilineal, patriarchal, and patrilocal in nature and has played a decisive role in perpetuating male dominance, gender inequality, and the exploitation of women. "China's traditional family system was without doubt one of the most brutally patriarchal in the world. The legal, economic, physical, and ideological mechanism by which it subordinated women has been detailed in many places and needs no repetition" (Greenhalgh 1985). The traditional family system emphasizes the importance of the father-son relationship and discourages intimacy between husband and wife. Furthermore, the power structure in this type of family is characterized by absolute control by the elders, and a young daughter-in-law has the lowest status in the family. She is under the direct control of her mother-in-law and usually cannot expect any support from her husband when she is mistreated. As China has undertaken its modernization process, however, this situation has gradually changed since the beginning of the last century. The changes entail a weakening of the traditional ideology and participation of women in the industrial labor force.

To simultaneously achieve rapid industrial development and to control city size, in the 1950s the Communist government implemented a high-employment/low-wage policy and began to employ the large untapped female labor reserve in the cities. The consequent economic independence and indispensable contribution to the family gave women increased bargaining power and changed their subordinate position in the family. That elevation of women's status not only changed interpersonal relations in the family, but also started to change the traditional patrilocal residence patterns. In recent years, more and more young couples choose to live with the wife's parents, thereby increasing the number of stem families. Eighteen percent of young couples who were married between 1977 and 1982 chose such a matrilocal residence, as compared with 8% of such residence arrangements 30 years before (see Table 2.4).

Wei Zhangling (1983) cited several dramatic changes that have taken place in Chinese families since 1949: (1) Monogamy has come true at last. (2) In cities, arranged marriages have shifted to free marriages. (3) Young people tend to marry later. (4) Family size is reduced, from extended families to nuclear ones. (5) The equality between husbands and wives has improved. (6) Household work is more often shared among family members.

The controversial one-child family policy implemented by the People's Republic of China in 1979 is one of the most significant programs of planned fertility that China has attempted. The one-child policy leads inexorably to disorganization of the traditional Chinese family and to promotion of gender equality in China. Hong (1987) forecasts

Table 2.4 Living Arrangements of Couples, by Wedding Cohort.

Year of Wedding	*-1937*	*1938-45*	*1946-49*	*1950-53*	*1954-57*	*1958-65*	*1966-76*	*1977-82*
Independent household	30.91	40.26	42.12	52.65	57.69	56.30	47.70	32.28
(Number)	(174)	(246)	(195)	(248)	(285)	(353)	(415)	(285)
With husband's parents	59.86	50.41	48.38	37.37	31.98	28.07	34.94	47.00
(Number)	(337)	(308)	(224)	(176)	(158)	(176)	(304)	(415)
With wife's parents	8.70	8.67	7.99	7.86	8.50	12.44	14.14	18.23
(Number)	(49)	(53)	(37)	(37)	(42)	(78)	(123)	(161)
Other	0.53	0.65	1.51	2.12	1.62	3.19	3.22	2.49
	(3)	(4)	(7)	(10)	(8)	(20)	(28)	(22)
Totals	100	100	100	100	100	99	100	100
(Number)	(563)	(611)	(463)	(471)	(494)	(627)	(870)	(883)

Source: Five-City Family Survey Research Group. 1985 *Five-City Family Survey*, p. 318

that the power of patriarchy would dwindle. However, other researchers have focused on a broad range of gender issues associated with adverse effects of the one-child policy; namely, female infanticide, the increased burden of pregnancy on women, forced abortion and sterilization, hazards to women's health, wife beating and abandonment, loss of status, loss of jobs, diminished wages, and sometimes more severe penalties for mothers than for fathers who defy the policy.

Using data on 1,130 Chinese in Beijing, Chow and Chen (1994) argue that the policy has a further unanticipated consequence, quite contrary to official expectations: it encourages the privatization of women in domestic labor and reproduction in the home. It reinforces, they argue, traditional gender-role relationships in families and strengthens the traditional patriarchal-family paradigm.

In the 1950s, 1960s and early 1970s, the emancipation rhetoric was persistent: “Gender equality has been achieved in the PRC.” But, as Edwards (2000) indicates, this official monotonous mantra has been joined by a multiplicity of refuting voices that recount vastly contradictory and diverse narratives about women’s lives and experiences in China. Following the market reforms, an increasing disparity between the sexes in economic and political power has clearly widened the gap between the prospects of men and women. Engel’s classical Marxist views that seek solutions to gender inequality by increasing women's participation in extra-familial productive activities, have in the Chinese revolutionary experience been found wanting. Stacy (1983) believes the disappointing outcomes came about because Communist leaders were unaware that Chinese socialism had its roots in a pro-patriarchal revolution; that is, socialism was brought to power by a peasant revolution that sought to restore and rehabilitate the traditional Chinese values of family. Johnson (1983) avers that deep beneath the Maoism that gave lip service to improving women's status lies the bedrock of Chinese patriarchy. Andors (1983) calls this revolution “the unfinished liberation of women” in China. Wolf

(1985) blames the failure of gender equality not on the lack of commitment to sexual equality by China's leaders, but on the insidiousness of a traditional patriarchal ideology that blinded them to the patriarchal bias in their own thinking and policies. Wolf also suggests that the current tide of reform that began in the late 1970s has not only swept away the ideological commitment to gender quality, but has also relegated women back to the traditional roles of good wife and mother. Andors (1983) maintained that the decollectivization efforts would hamper social reforms and undermine the ideology of equality. Johnson (1983) argues that new reforms may, in actual effect, strengthen the family system's control over its division of labor.

The economic reforms, in reality, have brought conflicting changes. on the one hand, women have shared with men some of the benefits of reform, such as higher living standards, better economic and career opportunities, and more desirable life styles. on the other hand, many women have found a disadvantage in the labor market and a more insecure future. In the political field, women's status has definitely worsened. For example, the proportion of women representatives in the National People's Congress (NPC) and other political institutions began to decline only a few years after the economic reforms were launched (Shang 1996). The proportion of women in basic-level civil-service cadres has declined sharply, too. Whereas in the 1950s, 70 percent of the villages in rural China had at least one woman head or director, in the 1990s only 10 percent of villages throughout the country have a woman head. In 1993, only about 3.8 percent of the country's township administrator were women, only 5.9 percent of the country's heads, and only 5.8 percent of the municipal managers (Wang 1999).

Zhang (1996) documents that women have readily embraced rural reform because it provides them a greater sense of autonomy and a more extensive array of choices. The government fails, however, to regard women's needs and interests as prime policy goals. Additionally, in rural areas, a severe bias exists against providing women opportunities for educational advancement. The government officially attributes rural women's disadvantaged position to the so-called "low quality" of female workers during the transition to non-agricultural employment in an increasingly competitive labor market. The government is thereby obviously shirking its responsibility. It blames the victims of sexual prejudice themselves for the social disadvantages they have experienced. The strikingly high suicide rates of rural women reflect their stressful life circumstances (Phillips 1999; Shiang 1998). Strong and pervasive preferences for sons and the heritage of Confucian patriarchal tradition are revealed in the abnormal sex ratios at birth (Poston et al. 1997; Kim 1997). For these reasons, the conclusions about progress in the status of Chinese women in this vast and varied mainland of China should be approached with some trepidation.

Women's Status in Taiwan

Taiwan is an immigrant society of China. Since the seventeenth century, traditional ideas of Chinese cultural legacy have been the dominant ideology. In 1885, Taiwan achieved provincial status in the Ching Dynasty. Between 1895 and 1945, Taiwan was a colony of Japan. Thus, the Taiwanese gender system was influenced by both Chinese Confucianism and Japanese male chauvinism. During half a century of colonial rule, the Japanese custom that men be well attended by women, while women should submit to men's domination, was transplanted into Taiwanese families. The husbands were masters of the family, while their wives were nothing but housemaids. Hence, before World War II, Taiwanese women's status was pretty much the same as in China, as described above.

The status of Taiwanese women experienced a change when the society moved from agriculture to secondary and tertiary industries in the 1960s and 1970s (Coombs and Sun 1981). That transition opened more work opportunities for females on this small island. With exposure to Western cultures (especially American), new ideas about sexual equality began to spread. In Taiwan, as in most countries, it became established that girls should go to school. Parents now encourage their daughters to participate in the labor force before they marry. During this development process, Taiwanese women joined the labor force and reduced their fertility. As the female participation rate increased, female marriage at first age and the crude birth rate showed a declining trend (see Table 2.5). Ku Yenlin (1988) notes that when the Nationalist government moved to Taiwan, "in order to counter the drastic social and political changes on the mainland, it took upon itself the role of maintaining tradition and tightening social control" (1988, p. 180). When martial law was proclaimed in 1948 (not to be lifted until 1987), restrictions were placed on nongovernmental organizations (NGOs) such that virtually all women's groups either were government-controlled, such as the Chinese Women's Anti-Communist Aggression League founded in 1950 by Madame Chiang Kai-shek, or were local branches of conservative international organizations such as the YWCA, the Zonta

Club, and the Taipei Jaycettes (Chiang and Ku 1985).

Table 2.5 Yearly Participation Rate of Both Sexes in Labor Force of Taiwan.

Year	Total	Male	Female
1951	67.56	89.97	42.12
1956	63.10	88.00	37.50
1961	61.75	86.37	35.81
1966	57.23	81.37	32.63
1971	57.07	78.35	35.37
1977	58.67	77.79	39.27
1978	58.76	77.79	39.13
1979	58.73	77.95	39.23
1980	58.26	77.11	39.25
1981	57.82	76.78	38.76
1982	57.93	76.47	39.30
1983	59.26	76.36	42.12
1984	59.72	76.11	43.30
1985	59.49	75.47	43.46
1986	60.37	75.15	45.51
1987	60.93	75.24	46.54
1988	60.21	74.83	45.56
1989	60.12	74.84	45.35
1990	59.24	73.96	44.50
1991	59.11	73.80	44.39
1992	59.34	73.78	44.83
1993	58.82	72.67	44.89
1994	58.96	72.44	45.40

Source: EYRC 1994a. (abridged) *Annual Report of Labor Statistics*

In a continuation of previous ROC policy on the mainland, women's status was declared to be equal to that of men, based on the 1947 Constitution: "All citizens of the republic of China, irrespective of sex, religion, race, class or party affiliation, shall be equal before the law." A nine-year compulsory education ensures equal educational opportunities for boys and girls between the ages of six and fifteen. The Labor Standards

Law, passed in 1984, forbids discrimination against any worker on the basis of sex. Special protection for women's political rights, motherhood, and family is further specified in the Constitution.

While their roles were seen to be complementary to those of men, women were expected to contribute to the stability and prosperity of Taiwanese society in their roles as wives, mothers, and volunteer workers. In the 1960s, young women and female graduates of elementary and junior high school were encouraged by the government to enter the work force, helping to fuel economic expansion (Gallin 1984). This economic prosperity in turn contributed to the growth of a new urban middle class in the 1970s, and government rhetoric once again valorized the wife and mother roles as the proper sphere of women (Diamond 1973). Rather than being the result of conscious interventionist social planning or agitation by Taiwan's women's movement, improvements of women's status in Taiwan have been the inadvertent results of the general rise for all Taiwanese in their standard of living and their participation in the political arena. This is in direct contrast to China's revolutionist style promoted by the PRC government.

The economic achievement of Taiwanese women is clear. Taiwan's shift in economic strategy from a labor-intensive (1965-1973) to a capital-intensive (after 1973) production had a significant impact on women's employment. Table 2.6 presents data on the occupational distribution of men and women over time. Between 1966 and 1986, the percentage distribution of men's and women's employment across various occupations was similar. Not only was the relative concentration of their employment across occupations the same, but the magnitude of the percentage distribution was not very different in many occupational categories in the earlier period. Thus, for both men and women, the most dominant occupation in the first decade (1966-76) was agricultural work, followed by production work. About half of the total number employed males (44 percent) and females (47 percent) in the early stage of industrialization worked in agriculture-related jobs. This proportion, however, has declined consistently since then. In 1993, it reached a level of less than one-fifth. on the other hand, during the same period, the proportions of men and women in production work increased. For males, they increased from 29 percent of total employed males in 1971 to 43 percent in 1986. Similarly, for women the increase was from 17 percent in 1971 to 36 percent in 1986. In 1993, however, women--but not men--showed a significant movement from production work to other occupational categories.

As a consequence of the shift in Taiwan to a capital-intensive economy, differences in the occupational distribution of men and women became more pronounced by 1986. Two types of differences are observed. First, a different concentration of male and female employment is seen across occupations. Although production work replaced agricultural work as the dominant occupation for both sexes in 1986, clerical work was the second largest occupation for women (18 percent), followed by agriculture (14 percent) and sales (14 percent). For men, the second largest employment was agricultural work (19 percent), followed by sales (13 percent) and clerical (11 percent). Agriculture did not appear to retain its capacity to absorb surplus female agricultural labor. On the contrary, the urban economy, with its expanding clerical work, provided the major source of employment for the younger female cohorts. This type of employment, however, is beyond the access of the agricultural surplus labor of the older generation. Taken together, these results suggest that older female surplus agricultural labor may either become unpaid family labor or go into the informal sector, which is part of the reserve army of industrial workers. This suggestion complements the findings of some anthropological studies (e.g., Gallin 1984).

The second difference is with regard to gender differences at the other end of the occupational hierarchy, that is, the professional and administrative positions. For both sexes, the percentage of administrators consistently declined, while that of professionals slowly increased. The rate of increase among female professionals (17 percent), however, was much smaller than among males (31 percent). Conversely for administrative jobs, the rate of decrease for females (85 percent) was much greater than for males (72 percent)-- in spite of a minor increase in 1993. In other words, for the upper end of the hierarchy, as industrialization proceeded the gender gap in status appeared to have widened.

Table 2.6 Distribution of Female and Male Workers by Occupations in Taiwan, 1966, 1971, 1976, 1981, 1986, 1993 (in percent).

				Men Workers Employed						
Year	Profes- sional, Technical	Admini- strative, Managerial	Clerical	Sales	Services	Agriculture	Mining	Transport, Communi cation	Production	Total
1966	4.55	4.40	7.30	10.42	5.08	42.37	1.59	4.06	20.22	99.99
1971	3.93	4.10	6.46	11.89	4.33	33.53	2.13	4.70	28.94	100.01
1976	4.99	3.11	7.86	11.87	5.17	28.75	----	----	38.26	100.01
1981	5.24	1.24	11.22	12.90	6.56	19.69	----	----	43.14	99.99
1986	5.97	1.24	11.20	13.32	7.11	18.52	----	----	42.63	99.99
1993	7.42	1.40	12.07	15.04	7.77	13.81	----	----	42.50	100.00
				Women Workers Employed						
1966	5.75	1.42	6.08	12.38	9.76	46.60	0.29	1.15	16.57	100.00
1971	4.55	0.87	7.1	13.31	7.85	37.21	0.40	0.97	27.73	99.99
1976	5.67	0.55	11.92	11.65	6.53	29.36	----	----	34.31	99.99
1981	6.29	0.18	17.53	12.81	9.30	16.40	----	----	37.48	99.99
1986	6.73	0.21	18.00	13.67	10.99	14.22			36.17	99.99
1993	8.96	0.28	23.93	15.65	13.25	9.33	----	----	28.59	100.00

Source: EYRC. 1994a. *Annual Report of Labor Statistics*

Table 2.7 Distribution of Ratio of Female and Male Workers to Total Employed, by Occupations in Taiwan, 1966, 1971, 1976, 1981, 1986, 1993 (in percent)

Year	Profes-sional, Technical	Admini-strative, Managerial	Clerical	Sales	Services	Agriculture	Mining	Transport, Communi cation	Production	Total
			Ratio of Men Workers to Total Employed							
1966	68.13	89.33	76.42	69.44	58.40	71.05	93.68	90.48	76.72	72.97
1971	65.22	91.1	66.43	66.01	54.55	66.22	92.03	91.33	69.42	68.51
1976	65.22	92.31	58.49	68.50	62.81	67.64	----	----	70.42	68.10
1981	62.47	93.22	56.13	66.82	58.52	70.59	----	----	69.71	66.66
1986	59.50	90.91	50.75	61.73	51.73	68.32	----	----	66.12	62.35
1993	58.02	89.29	45.73	61.60	49.47	71.18	----	----	71.28	62.55
			Ratio of Women Workers to Total Employed							
1966	31.87	10.67	23.58	30.56	41.60	28.95	6.32	9.52	23.28	27.03
1971	34.78	8.90	33.57	33.99	45.45	33.78	7.97	8.67	30.58	31.49
1976	34.78	7.69	41.51	31.50	37.19	32.36	----	----	29.58	31.90
1981	37.53	6.78	43.87	33.18	41.48	29.41	----	----	30.29	33.34
1986	40.50	9.09	49.25	38.27	48.27	31.68	----	----	33.88	37.65
1993	41.98	10.71	54.27	38.40	50.53	28.82	----	----	28.72	37.45

Source: EYRC. 1994a. *Annual Report of Labor Statistics*

As the other indicator of gender gap in occupational attainment, the sex composition of occupations is shown in Table 2.7. This variable can be used to assess the validity of predictions by female marginalization theories about feminization of marginal occupations. Several points are worthy of attention. Overall, in the past two decades, there was a significant increase (11 percent) in the visibility of females in the production system. From 1966 to 1993, the percentage of females to total employed increased from 27 percent to 37 percent. Among all occupations, the increase was greatest among clerical workers, where the ratio of females to total employed increased from 24 percent in 1966 to 54 percent in 1993. The magnitude of this increase was more than twice that of the increase of women in the workplace. Most of the remaining fields experienced 10 percent gains, except for the gradual leveling to the 1966 standard in administrators and managers, and the clear shrinkage in production in the 1990s. The only occupation in which women experienced a decline was agriculture. The occupational category of administrators and managers, however, is still segregated by sex to a high degree. Women are therefore underrepresented in that important part of the occupational system.

In reviewing women’s labor history in Taiwan, Wang (1994) finds that although women improved their labor participation rate to 45%, they still lag behind the female participation rates of western countries, as well as of Japan (50.7%). There are both structural and legal drawbacks associated with female employment. Married women tend to withdraw from the labor force after marriage and after childbirth (refer to Table 2.8). The labor participation rate for married women with children under six years old is 43%.

In view of an average participation rate of 60 percent for such women in western countries, insufficient daycare in Taiwan could be one factor contributing to this discrepancy. Throughout various family life cycles, women often sacrifice employment opportunities in order to manage the double challenge of family and work. Several studies in Taiwan have confirmed such a pattern of conforming to social norms. The Directorate-General of Budget, Accounting, Statistics, Executive Yuan (1991) reports that 30.3% of married women age 15-64 left jobs for marriage. Yi and Chien (2001) found continuous employment is just 43.7% for married Taiwanese women.

Wage differentials between men and women in Taiwan have been documented by numerous studies. Table 2.9 compares the difference of industry distribution and salary by gender. In 1989, the average salary of women with a high school education was 66 percent of that of men with the same educational achievement. At the junior college level and beyond, the average salary of women was 69 percent of that of men. Tseng (2001) finds that average incomes of males in 1982, 1992, and 2000 exceeded that of females by, respectively, 30%, 31% and 27%. He further argues that occupational segregation is the most important factor accounting for this discrepancy. Liao and Cheng (1985) found, moreover, that discrepancies in pay between the sexes are larger in private industry than in government employment. Lin's (1988) study further indicates that unequal pay for equal work directly contributed to the wage differential by sex. Tam (1996) finds in the 1991 Taiwan Social Survey that a large part of the gender gap appears to have resulted from gender differences in constraints associated with family roles. Discriminatory treatment against women in promotion, salary increases, and provision of in-service training is significantly more frequently and seriously perceived by women than by men (Yu 1991).

Table 2.8 Yearly Married Women Labor Participation Rate in Taiwan Unit: %.

Year	Average	with Children over 18 years old	with Children 6~17 years old	with Children under 6 years old	No Children
1979	31.72	21.98	39.16	28.73	43.01
1980	33.23	23.52	43.90	28.91	39.10
1981	31.42	22.15	39.93	28.26	39.30
1982	31.51	21.91	40.02	28.99	41.12
1983	35.53	25.24	43.68	33.40	48.89
1984	38.74	27.06	47.82	37.34	50.88
1985	39.84	27.92	49.06	38.99	48.64
1986	41.82	29.88	51.71	40.55	50.62
1987	43.74	30.45	54.18	42.95	56.75
1988	42.66	30.15	52.20	42.40	56.49
1989	43.65	30.00	53.54	44.64	54.79
1990	42.49	29.14	52.06	43.70	55.21
1991	44.00	32.02	52.56	44.36	60.45
1992	43.23	30.28	54.25	42.30	58.24
1993	44.39	31.32	55.76	42.99	59.72

Source: EYRC. 1994b. *Human Power Investigation of the Republic of China.*

Table 2.9 The Comparison of Size and Salary of Female and Male Workers by Industry in the Taiwan, 1975, 1980, 1985, 1990, 1991.

Industry	Male (Thousand) (1)	Female (Thousand) (2)	% (2)/(1)	Male Salary (NT Dollar) (3)	Female Salary (NT Dollar) (4)	% (4)/(3)
Total						
1975	1022	755	73.9	22754	12545	55.1
1980	1733	1395	80.5	62792	39806	63.4
1985	2078	1744	83.9	110292	71920	65.2
1990	2082	1725	82.9	185438	125377	67.6
1991	2045	1697	83.0	204160	139395	68.3

Table 2.9 (Continued)

Industry	Male (Thousand) (1)	Female (Thousand) (2)	% (2)/(1)	Male Salary (NT Dollar) (3)	Female Salary (NT Dollar) (4)	% (4)/(3)
Mining and Quarrying						
1975	56	8	14.3	5582	2174	38.9
1980	41	8	19.5	12699	5835	45.9
1985	28	5	17.9	17524	9022	51.5
1990	16	3	18.8	28094	15020	53.5
1991	15	3	20.0	30523	16932	55.5
Manufacturing						
1975	730	671	91.9	-	-	-
1980	1003	993	99.0	-	-	-
1985	1283	1176	91.7	15402	9762	63.4
1990	1239	1021	82.4	26941	16395	60.9
1991	1204	982	81.6	29904	18119	60.6
Commerce						
1975	-	-	-	-	-	-
1980	303	201	66.3	11203	5760	51.4
1985	336	296	88.1	16595	10242	61.7
1990	374	356	95.2	27459	19075	69.5
1991	369	361	97.8	29535	20947	70.9
Transport, Storage, Communication						
1975	163	38	23.3	5815	4589	78.9
1980	199	54	27.1	11579	8610	74.4
1985	207	58	28.0	18532	14058	75.9
1990	205	61	29.8	30531	24336	79.7
1991	205	60	29.3	35099	28497	81.2
Services						
1975	73	38	52.1	11348	5982	52.7
1980	96	54	56.3	16559	10492	63.4
1985	112	58	51.8	26353	17628	66.9
1990	134	61	45.5	43884	30855	70.3
1991	138	60	43.5	47496	33096	69.7
Public, Social Administrations						
1975	-	-	-	-	-	
1980	91	87	95.6	10752	9109	84.7
1985	110	124	112.7	13886	11208	80.7
1990	114	144	126.3	28527	19693	69.0
1991	114	146	128.1	31603	21874	69.2

Source: EYRC. 1993. *Taiwan Human Resource Report.*

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Even as women entered the paid labor force their status in the family did not seem to change. Lu's (1981) in-depth interviews of 58 women in three rural communities found that the women's participation in the industrial labor force was not accompanied by a significant change in their family status and roles nor in the family's adjustment to the women's employment. Gallin (1982) established that daughters who turned in a good portion of their wages to their natal families did not win equal opportunity because most of them lacked skills and knowledge that would have enabled them to have alternatives to the traditional arrangement of marriage and family. Gallin concluded that development in Taiwan changed neither the cultural definitions of male and female roles nor the structure of status and authority within the family. Kung (1983) analyzed the effects of women's work on their position and self-image and concluded that while working does allow women physical mobility and provide money for better clothing and recreational activities, new economic roles do not evolve into higher familial status.

Notwithstanding the misgivings pinpointed by the research reviewed thus far, there are still positive signs for women’s status in Taiwan. From the life-course perspective, in her research on women’s status since 1958, Margery Wolf (1972) wrote that in rural Taiwan crucial differences were observed in the status of Chinese women as a function of a woman’s position in the life cycle. If a woman had sons who remained at home with their wives, she occupied a key role in the extended family, influencing many household decisions. Sung, an anthropologist who conducted fieldwork in northern Taiwan between 1972 and 1981, discovered that Taiwanese women in the rural areas were not powerless by any means (Sung 1983). Li (1987) compared results of sex-role scales from different cohorts of college students in Taiwan and argued that psychologically recent cohorts of Taiwanese women generally had more masculine qualities than Taiwanese women previous to the recent major social change. Tong and Zeng (1990) examined married women from one city area and one rural area in Taiwan and concluded that married women's working status also makes them more inclined to be nontraditional. Yao (1987) studied 341 women in fourteen Taiwanese villages and found that attitudes and the household division of labor had become more egalitarian. Nonetheless, even while women's levels of education and employment have increased concurrently with attitudinal changes, most household tasks continue to be performed by women.

Hu (1985) reasoned that as a result of rural industrialization, the male family head has less control over the younger generation that is engaged in industrial work. Further, in all types of families, daughters and daughters-in-law now enjoy more autonomy, whereas the status of mothers-in-law has become lower. Young women's status has substantially improved in at least two regards. First, a young working woman's parents now usually transfer into the young woman's dowry the full bride price from the husband's side. thereby giving them extra money to raise the young woman's marriage status. Second, married daughters maintain closer ritual relations with their natal families: in research on urban women, Tsui (1985) focused on parents' investment in their children's education, as well as on the subsequent role changes of highly educated working women in relation to their families. She concluded that women improved their positions in the family by continuing an economic relationship with their natal families after marriage.

Examining data from several surveys from 1965 to 1986 focusing on female respondents, and analyzing household registration data and census data from 1905 to 1990, Thornton and Lin (1994) inferred that changes in traditional Taiwanese familial attitudes were coming about because women were changing their models of interpersonal organization from a familial model toward a nonfamilial model. The crude Taiwanese divorce rate in 1988 was 1.3, very close to the Japanese divorce rate of 1.2. Both of these rates appear to be higher than others of East Asia. Over the time spans studied, Thornton and Lin identified trends toward reduced fertility preferences, movement away from arranged marriages toward love matches, increased sexual intimacy before marriage, increased premarital pregnancy, and an increasing potential for remaining single.

Despite social changes, co-residence of a married couple with the husband's parents has continued to be an important aspect of family life, according to Weinstein and associates (1990). Chien and Yi (2001) report that living arrangements for married Taiwanese women are as follows: always nuclear (36.4%), always paternal stem family (24.3%), always paternal extended family (9.4%), divided between stem and nuclear family (11.9%), and divided between extended and nuclear family (5.3%). A decade before, Coombs and Sun (1981) and Chang (1986) found that attitudes about children supporting their parents in old age lagged behind other attitude changes. Patrilineal and patrilocal living arrangements still prevail in Taiwan. In general, the older the marriage cohort, the more likely a married woman would live with her husband's parents at the time of marriage. Among married women who had lived with parents-in-law since marriage, the duration of co-residence has tended to decrease over time (refer to Table 2.10). The traditional filial obligations can be fulfilled during the period of co-residence, while the benefits of nuclear family living can be enjoyed during the remainder of the lifetime. This new form of adjustment maintains certain aspects of traditional values without a lifetime commitment to the extended family system. It is a rational and practical response to a rapidly changing social world.

Yi and Lu (1996) review the past thirty years of research on sex-role attitudes and conclude that women are now accepted as having working roles outside the home and are entitled to look for their own careers; however, when they come home, they expect and are expected to be good at taking care of their families. It is clear that nontraditional sex role attitudes do not fully spill over into the family system, the main stage of the male-dominated world within the Confucian values framework.

Female work patterns in Taiwan in terms of formal versus informal employment are determined by family organization rather than by market conditions, according to Lu (1994) who examined female marginalization in Taiwan. Women from families with small businesses, especially from families who have young children, are more likely to undertake informal rather than formal employment. In part, this is due to the division of labor in the family by sex. This arrangement is also likely because of the prevalence of small family businesses in Taiwan. Accordingly, these work patterns are not produced by exclusion of women from capitalistic production work. The plight of modern working women continues in Taiwan: they must balance family responsibilities and their careers.

Table 2.10 Percent of Couples Who Have Lived with Parents after Marriage by Marriage Cohorts for Married Women Aged 15 to 49 in Taiwan, 1985.

	Marriage Cohorts					
Year	81-85	76-80	71-75	66-70	61-65	Prior 1961
1. Wife's Parents						
Total	611	645	478	372	284	233
Yes	96.0	96.6	39.9	28.3	39.3	39.3
No	4.0	3.4	40.0	29.0	41.1	41.1
2. Husband's Parents						
Total	611	645	478	372	284	233
Yes	23.4	26.2	26.9	21.2	18.0	15.0
No	76.6	73.8	73.1	78.8	82.0	85.0
3. Months of Co-residence *						
1-6	100.0	100.0	100.0	100.0	100.0	100.0
7-12	84.4	92.9	93.4	94.6	97.2	99.0
13-18	72.2	87.7	88.8	90.7	94.8	97.0
19-24	59.9	84.0	85.5	88.1	92.7	96.6
25-30	47.9	79.8	81.1	83.3	90.0	93.1
31-36	36.9	77.3	79.7	81.9	88.6	91.4
37-42	26.1	72.5	75.4	77.1	86.0	87.8
43-48	19.2	70.5	74.4	76.4	85.1	86.9
49-54	12.4	65.9	71.7	75.0	83.9	85.5
55-59	8.6	63.4	70.6	74.7	83.4	84.9
60+	7.8	61.9	69.6	74.2	82.9	84.2

Source: EYRC. 1985a. *Taiwan Labor Force Survey*

*Percent of couples who still lived with the husband's parents at the end of six months after marriage.

Formal education in Taiwan was initiated by the Japanese colonial empire and later expanded by the Nationalist government. During Japanese rule (1895-1945), the proportion of school-aged girls enrolling in elementary schools increased from 1.02 percent in 1908 to 61.0 percent in 1943, and the corresponding increase for boys was 8.2

percent to 80.7 percent (Yu 1988, p. 286). Statistics from 1974 indicate that 20 percent of women were illiterate, compared with 7.25 percent of men; that 73.24 percent of women received elementary education or less, compared with 59.74 percent of men; and that 3.32 percent of women received a college education or above, compared with 6.89 percent of men.

Since World War II, and especially since the 1960s, Taiwan has experienced extraordinary economic growth and social change, including a considerable expansion of its educational system. According to educational statistics of the Republic of China in 1987, the ratios of female to male students in elementary schools, secondary schools, and colleges were 1:1.05, 1:1.07 and 1:1.36, respectively. The enrollment rate for girls aged 6-11 rose from 68.6 percent in 1951 to 99.9 percent in 1989, when it reached the same level as the enrollment rate for boys (Ministry of Education 1990, p. 28). An increase in net enrollment rates for females in secondary education is also seen. In the academic year 1988-89, the enrollment rate for females aged 12-17 was 84.6 percent, which was higher than that for males of the same age (81.3 percent). Among the group aged 18-21, the enrollment rate for women (9.0 percent) was approximately the same as that for men (15.9 percent) in that same year (Ministry of Education 1990, p. 32). In terms of educational attainment, Table 2.11 informs us that the discrepancy across gender has been eliminated. The goal of equal educational opportunity seems to have been achieved.

A general picture of gender differences in educational attainment in Taiwan is seen in Table 2.12 (Tsai et al. 1994), which reports the mean years of schooling

Table 2.11 Educational Attainment of Population Aged 6 and over (%).

	1980		1985		1990		1993	
	Male	Female	Male	Female	Male	Female	Male	Female
First Level (6-11 years)	50.64	48.27	43.59	44.93	36.11	38.98	31.18	34.19
Second Level (12-17 years)	29.72	18.07	37.08	26.32	44.33	35.53	48.01	40.79
Third Level (18-21 years)	11.11	5.32	13.26	7.24	15.05	9.43	16.90	11.39

Source: EYRC. 1997. *Statistical Yearbook of the Republic of China 1997.*

Table 2.12 Mean Years of Schooling, by Gender, Cohort, and Ethnicity (N= 2, 866).

	Ethnicity			
Year of Birth	Hokkien	Hakka	Mainlander	Total
Men (n =1477)				
1927-44	7.71	7.14	9.81	7.91
1945-55	9.73	10.73	14.08	10.2
1956-71	11.6	12.13	12.67	11.78
Total	10.05	9.96	12.12	10.28
Women (n= 1,389)				
1927-44	4.38	4.09	9.9	4.87
1945-55	8.2	8.68	12.48	8.73
1956-71	10.8	12.09	12.58	11.09
Total	8.58	8.98	11.99	8.97

Source: Tsai, Shu-Ling, Hill Gates, and Hei-Yuan Chiu. 1994.

completed by men and women. The average level of education attained by women is lower than that of men, irrespective of ethnicity and cohort. But, the gender gap declines across cohorts because education has been expanded over the years. Furthermore, in the youngest cohort examined, differences in average years of schooling between men and women are no longer statistically significant among both the Hakkas and the Mainlanders, whereas a gender difference is still obvious among the Hokkien. Luoh

(2001), using data from the 1990 census, confirms that there is still an ethnic group difference and that gender differences within ethnic groups still persist. In the 1960 cohort, however, there is no difference by gender for the probability of entering college.

Politics in Taiwan, as in many other societies, is almost exclusively a male domain. Still, participation of women in politics has increased in all levels of public office, and especially in high-ranking government positions. Taiwan has made impressive strides toward increasing women's representation in all its legislative bodies (now in the 15 to 20 percent range) thanks to the reserved seats system, which is based on the provision in the 1947 Constitution that "reserves" about 10 percent of legislative seats for women (Lee 2000). Recently, local women's organizations and associations for various purposes have emerged, indicating a rapid rise in women's social participation. However, these groups are primarily populated by well-educated women with white-collar jobs and/or by middle-class housewives. Only one association, the Women’s New Awakenings Foundation, openly promotes feminism. In 1972, Lu Hsiu-lien (Annete Lu, currently the Vice President of Taiwan) launched the feminist movement in Taiwan, contrary to the KMT ruling party's policy on women, which aimed at preserving the patriarchal tradition.

The Comparison between Taiwan and China

Taiwan and China are viewed as possessing similar cultural traditions but different political and social systems. In 1971, Taiwan faced a significant decline in its international position when its seat as “China” within the United Nations passed to the

People's Republic of China (PRC) on the mainland. As a result, we cannot directly compare them based on the Gender-Related Development Index (GDI) and the Gender Empowerment Measure (GEM) of the United Nations. Yao (1983) emphasized the sharply different expectations between the two societies regarding women's roles. Whereas women in mainland China were expected to live up to their potential by contributing their share to socialist construction, young women in Taiwan were educated to place their families before careers. Therefore, Taiwan tends to have a more traditional family pattern, and women have a more inferior status than in mainland China. Meng (2000) compares the effects of institutions and culture on the economic position of women in the PRC and Taiwan. She finds that the proportion of the female-male wage gap attributed to discrimination is much larger in Taiwan than in the PRC. She argues that the promotion of gender equity in the PRC's socialist period has been very effective. Hsieh and Burgess (1994) found that college students in the PRC expressed more egalitarian attitudes towards the importance of the wife's career and husband-wife role alterations, while students in Taiwan care more about institutionalized equality. However, they believe China is destined to deteriorate after economic reform. Taiwan has moved more toward the progressive way. Yi and associates (2000), compared women's family status in Tianjin, a northern metropolis in China, and in Taiwan. They, too, found that Tianjin couples possess stronger concepts of gender egalitarianism than their Taiwanese counterparts.

In term of laws and regulations to protect women, China overshadows Taiwan. In China, for example, three recently passed laws ensuring Chinese women's rights and interests are the Provisional Regulations for Health Care for Women Employees (known as the 1986 Health Care Regulations), the Regulations Governing Labor Protection for Female Staff Members and Workers (known as the 1988 Labor Protection Regulations), and the 1992 Law on Protection of Rights and Interests of Women. In Taiwan, on the other hand, in spite of several codes about the protection of women, there are no such laws dispersed in Labor Standard Law that specifically provide for the protection of women.

Regarding the division of household labor, in China, even though women still perform 66% of household labor, men's participation in housework is common, (Skinner and Meredith 1998). Chinese husbands have shown a greater degree of equal sharing in housework than have husbands in Russia, Czechoslovakia, France, the United States, Great Britain, Japan, and Hong Kong (Greer 1992; Wang and Li 1982; Bonney et al. 1992; Xuewen et al. 1992). The majority of wives and husbands perceived fairness in their division of housework (Zuo and Bian 2001). However, Sanchez (1994) studied the results of the International Value of Children surveys conducted in 1975 and 1977, comparing husbands' housework participation internationally. In hours of husband sharing housework, Taiwan slightly outranks the Sundanese of West Java, Indonesia, a Muslim area, and lags behind Japan, the Philippines, South Korea and the United States. Hu and Kamo (2003) could not find an association between women's economic resources and their share of housework in the 1995-1996 Taiwan Social Survey. Judging from my personal experiences in contact with people from mainland China, I have found that most married men from China can and will cook meals for his family, but men from

Taiwan will not. Married men from China always say to me that Taiwanese men are more blessed than they. While rapid economic growth in the past three decades in Taiwan has improved women's socioeconomic status, gender biases based on traditional value systems still tend to prevail in attitudes toward gender roles at work and in family life.

CHAPTER III

DEMOGRAPHIC TRANSITION IN TAIWAN AND CHINA

China

Since the founding of the People's Republic of China in 1949, China has experienced a dramatic change in its fertility. Over the 40 years from 1949 to 1989, China doubled its population but, at the same time, experienced a 50% reduction in both the crude birth rate (CBR) and the total fertility rate. China's population has grown from 542 million in 1949 to 1.3 billion in 2001 (Table 3.1), with an annual average population growth rate of 1.63% during these fifty years. The process is a demographic outcome of two baby booms with two significant reductions in the CBR, and a gradual decline in the CDR (Crude Death Rate). The first baby boom transpired during the period of 1949 to 1958. In this period, the CBR was as high as 37 per thousand while the CDR decreased continuously from 20 per thousand to 10.8 per thousand. As a result, within a decade China experienced a net increase of more than a hundred million people in its total population within a decade. Following the first baby boom, the first significant reduction in the CBR occurred, declining from 29.2 per thousand in 1958 to 18.0 per thousand in 1961. This reduction in fertility, accompanied by an increase in the CDR, resulted in a decline in China's population, from 672 million in 1959 to 662 million in 1960 and 659 million in 1961. The three-year famine, caused in part by natural disasters and partly by the government's economic failures, was the major contributor to the decline in the size

Table 3.1 Population Size and Vital Rates of China, 1949-1988.

Year	Total Population (Million)	Total Fertility Rate	CBR	CDR	NIR
			(Per Thousand)		
1949	541.67	-	36.00	20.00	16.00
1950	551.96	5.81	37.00	18.00	19.00
1951	563.00	5.70	37.80	17.80	20.00
1952	574.82	6.47	37.00	17.00	20.00
1953	587.96	6.05	37.00	14.00	23.00
1954	602.66	6.28	37.97	13.18	24.79
1955	614.65	6.26	32.60	12.28	20.32
1956	628.28	5.85	31.90	11.40	20.50
1957	646.53	6.41	34.03	10.80	23.23
1958	659.94	5.68	29.22	11.98	17.24
1959	672.07	4.30	24.78	14.59	10.19
1960	662.07	4.02	20.86	25.43	-4.57
1961	658.59	3.29	18.02	14.24	3.78
1962	672.95	6.02	37.01	10.02	26.99
1963	691.72	7.50	43.37	10.04	33.33
1964	704.99	6.18	39.14	11.50	27.64
1965	725.38	6.08	37.88	9.50	28.38
1966	745.42	6.26	35.05	8.83	26.22
1967	763.68	5.31	33.96	8.43	25.53
1968	785.34	6.45	35.59	8.21	27.38
1969	806.71	5.72	34.11	8.03	26.08
1970	829.92	5.81	33.43	7.60	25.83
1971	852.29	5.44	30.65	7.32	23.33
1972	871.77	4.98	29.77	7.61	22.16
1973	892.11	4.54	27.93	7.04	20.89
1974	908.59	4.17	24.82	7.34	17.48
1975	924.20	3.57	23.01	7.32	15.69
1976	937.17	3.24	19.91	7.25	12.66
1977	949.74	2.84	18.93	6.87	12.06
1978	962.59	2.72	18.25	6.25	12.00
1979	975.42	2.74	17.82	6.21	11.61
1980	987.05	2.31	18.21	6.34	11.87
1981	1000.72	2.61	20.91	6.36	14.55
1982	1015.90	2.86	21.09	6.60	14.49
1983	1027.64	2.42	18.62	7.08	11.54
1984	1038.76	2.35	17.50	6.69	10.81
1985	1050.44	2.20	17.80	6.57	11.23
1986	1065.29	2.42	20.77	6.69	14.08
1987	1080.73	2.59	21.04	6.65	14.39
1988	1096.14	2.52	20.78	6.58	14.20
1989	1127.04	2.35	21.58	6.54	15.04

Table 3.1 (Continued)

Year	Total Population (Million)	Total Fertility Rate	CBR	CDR	NIR
			(Per Thousand)		
1990	1143.33	2.31	21.06	6.67	14.39
1991	1158.23	2.20	19.68	6.7	12.98
1992	1171.71	1.82	18.24	6.64	11.6
1993	1185.17	1.81	18.09	6.64	11.45
1994	1198.5	1.79	17.7	6.49	11.21
1995	1211.21	1.76	17.12	6.57	10.55
1996	1223.89	1.80	16.98	6.56	10.42
1997	1236.26	1.80	16.57	6.51	10.06
1998	1247.61	-	15.64	6.5	9.14
1999	1257.86	-	14.64	6.46	8.18
2000	1267.43	-	14.03	6.45	7.58
2001	1276.27	-	13.38	6.43	6.95

Sources: NBSC. 2002. *Statistical Yearbook of China 2002*.

of the Chinese population. China's second baby boom began when the famine was over in 1962. It lasted almost a decade, from 1962 to 1970. During this period, the CBR first went up quickly from 18.0 per thousand in 1961 to 27.0 in 1962 and 43.4 in 1963 and then remained above 30 per thousand throughout the rest of the decade. Meanwhile, the CDR continued to decrease from 14.2 per thousand in 1961 to 7.6 per thousand in 1970. In total, this second baby boom added about 170 million individuals to China's population.

In the beginning of the 1970s, China entered its second dramatic fertility decline, largely resulting from the state's continuous efforts to limit its population growth. During this time, while the CDR has remained almost unchanged, the CBR first decreased from 33.4 per thousand in 1970 to 17.8 per thousand in 1979 and then has stabilized around 20 per thousand. Consequently, the NRI (Natural Rate of Increase) declined dramatically from 25.8 per thousand in 1970 to 11.6 per thousand in 1979. Since 1979, the NRI has fluctuated slightly, but at a low level. These data, therefore, indicate that China needed only a decade to complete its demographic transition.

The dramatic decline in the CBR in China was mainly caused by a rapid drop in the TFR (Total Fertility Rate) since 1970 due to significant changes in age-specific fertility patterns. The total fertility rate increased from about 5.4 at the founding of the PRC to 6.1 in the first baby boom. It decreased to 3.2 in the famine years, and then increased to 6.1 again in the second baby boom. The TFR finally fell from 5.4 in 1971 to 2.6 in 1981.

The decline in the TFR, especially since the 1970s, was a result of three factors. The first is postponement of childbearing promoted by the government's later-marriage requirement. The second factor is the earlier relinquishment of the reproductive phase of life in order to conform to the "fewer" requirement in the 1970s and to the one-child fertility policy after 1979. The third factor is the role played by socioeconomic development (Poston and Gu 1987)

In spite of the one-child policy introduced in 1979 and various family-planning campaigns, the fertility decline slowed down after the rapid decline observed in the 1970s. Both the crude birth rate and the total fertility rate experienced significant fluctuations during this period, maintaining rates of about of 20 per thousand and 2.5 children per woman, for the CBR and TFR, respectively.

Fertility declined further and reached the below-replacement level (2.1) around 1991. Fertility in the urban and rural areas started to converge. In 1994, China's natural population growth rate stood at 1.12%, the lowest ever in its history (Wu 1997). However, deterioration in the quality of demographic data in recent years has led to considerable disagreement and speculation about recent fertility trends and the causes (Feeney and Yuan 1994).

In China, provincial fertility differentials from 1960 to 1987 are reported in Table 3.2 for the crude birth rates, the crude death rate, and the natural increase rates. Table 3.3 displays total fertility rate. Provincial differences in the CBR had increased since 1961, reaching the largest difference, 26.5 per thousand, in 1970. During the 1980s, the gap had decreased to a low of about eight per thousand. Differences among the provinces in total fertility rates were relatively constant over the period with a value of about two. However, even during the one-child policy years of 1979 to 1982, there were eight provinces and autonomous regions whose inhabitants, about one-fifth of the total population, still had more than three children on average. In terms of total fertility rates, during the period of 1979 to 1982, Shanghai’s was 1.2, the lowest in the country. Actually, this city’s fertility rate had started to decline in the 1960s. Guizhou, Qinghai, and Ningxia’s TFR remained above 4. Hence, there are marked regional differences in the timing and pace of the fertility transition. Peng (1989) points out that there is considerable variation in the fertility behavior of women with different educational backgrounds, work statuses, and places of residence.

Table 3.2 Provincial Population Size and Vital Rates (Per Thousand) in China, 1961, 1965, 1970, 1975, 1980, and 1984-87.

			1961			1965			1970	
Province	Population	CBR	CDR	NIR	CBR	CDR	NIR	CBR	CDR	NIR
Beijing	0.99	25.7	10.8	14.9	23.1	6.7	16.4	20.7	6.4	14.3
Tianjin	0.77	-	-	-	-	-	-	19.3	6.4	12.9
Hebei	5.28	15.4	13.4	2.0	31.8	8.4	23.4	26.8	6.5	20.3
Shanxi	2.51	19.0	12.2	6.8	34.0	10.4	23.6	31.1	8.1	23.0
Neimenggu	1.91	22.1	8.6	13.4	38.0	9.6	28.4	28.9	5.8	23.1
Liaoning	3.49	17.3	17.1	0.1	36.2	7.1	29.1	27.4	5.1	22.3
Jilin	2.17	26.5	12.0	14.4	40.5	9.7	30.8	33.2	6.3	26.8
Heilongjiang	3.17	27.3	11.1	16.1	40.4	8.0	32.4	34.8	5.8	29.0
Shanghai	1.16	22.5	7.7	14.8	17.0	5.7	11.3	13.9	5.0	8.9
Jiangsu	5.87	18.6	13.2	5.4	36.9	9.5	27.4	30.7	6.9	23.8
Zhejiang	3.81	17.6	9.8	7.7	36.5	8.1	28.4	26.2	6.0	20.1
Anhui	4.90	12.3	8.1	4.2	41.8	7.2	34.6	37.2	6.4	30.8
Fujian	2.60	17.4	11.9	5.6	41.1	7.3	33.8	33.4	6.0	27.4
Jiangxi	3.29	21.0	11.5	9.5	38.9	9.4	29.5	31.6	7.7	23.8
Shandong	7.36	21.5	18.5	3.1	35.5	10.2	25.3	33.9	7.3	26.6
Henan	7.37	15.3	10.2	5.1	36.1	8.5	27.6	31.6	7.4	24.2
Hubei	4.74	27.2	9.1	18.1	35.1	10.0	25.1	29.9	7.7	22.2
Hunan	5.36	12.5	17.5	-5.0	42.3	11.2	31.1	37.2	10.2	27.1
Guangdong	5.97	21.5	10.7	10.8	36.3	6.8	29.5	29.6	5.9	23.8
Guangxi	3.72	16.0	20.1	-4.1	42.4	9.0	33.4	31.1	6.8	27.5
Hainan	9.67	11.7	28.0	16.4	42.4	11.5	30.9	52.7	12.6	40.1
Sichuan	2.84	15.8	20.0	-4.2	50.0	15.2	34.8	43.1	10.8	32.3
Guizhou	3.27	19.4	11.8	7.6	44.1	13.0	31.1	28.5	8.2	20.4
Yunnan	0.19	-	-	-	-	-	-	19.4	7.6	11.8
Shaanxi	2.86	21.0	8.8	12.2	34.7	13.0	21.7	26.8	6.3	20.5
Gansu	1.96	14.8	11.5	3.3	45.3	12.3	33.0	39.5	7.9	31.5
Qinghai	0.40	11.4	11.7	-0.3	48.7	9.1	39.6	39.9	7.6	32.4
Ningxia	0.40	13.0	10.7	2.3	48.1	9.3	38.8	40.4	6.4	33.9
Xinjiang	1.32	25.5	1.0	14.5	41.7	11.1	30.6	36.7	8.2	28.4
Total	100.00%	18.1	14.3	3.8	38.0	9.5	28.5	33.6	7.6	26.0

Table 3.2 (Continued)

Province	1975 CBR	1975 CDR	1975 NIR	1980 CBR	1980 CDR	1980 NIR	1984 CBR	1984 CDR	1984 NIR
Beijing	9.9	6.5	3.4	15.6	6.3	9.3	15.4	5.5	10.0
Tianjin	13.9	6.6	7.4	13.5	6.0	7.4	16.0	5.4	10.6
Hebei	15.6	7.2	8.4	19.6	7.3	12.4	14.0	5.8	8.3
Shanxi	23.2	7.9	15.4	17.5	6.7	10.8	14.4	6.0	8.4
Neimenggu	22.2	5.7	16.5	18.5	5.5	13.1	16.6	4.5	12.1
Liaoning	16.4	6.2	10.2	15.8	5.6	10.2	10.8	5.0	5.8
Jilin	20.5	6.7	13.7	17.9	6.2	11.7	11.8	5.3	6.5
Heilongjiang	22.0	5.4	16.5	23.6	7.2	16.3	11.0	4.5	6.6
Shanghai	9.4	6.0	3.4	12.6	6.5	6.1	13.7	6.5	7.1
Jiangsu	17.9	6.5	11.4	14.7	6.6	8.1	10.4	5.9	4.5
Zhejiang	19.5	6.3	13.2	15.1	6.3	8.8	12.5	6.0	6.5
Anhui	22.1	5.7	16.5	15.5	4.7	10.8	13.0	5.3	7.6
Fujian	28.8	6.5	22.3	18.7	6.5	12.1	18.9	5.6	13.3
Jiangxi	34.0	8.0	26.0	16.0	5.3	10.7	14.8	5.9	8.9
Shandong	21.6	7.5	14.0	15.3	6.6	8.7	13.0	6.0	0.7
Henan	22.8	7.7	15.1	17.3	5.2	12.0	11.2	6.3	4.9
Hubei	19.9	7.9	12.1	16.5	7.1	9.4	13.5	6.9	6.6
Hunan	25.0	8.3	16.7	16.2	6.9	9.3	14.6	6.8	7.8
Guangdong	21.0	6.1	15.0	20.7	5.4	15.3	17.5	5.2	12.4
Guangxi	27.5	6.8	20.8	22.9	5.9	17.0	21.5	5.2	16.3
Hainan	29.1	8.9	20.3	11.9	6.8	5.1	10.2	6.8	3.5
Sichuan	37.5	10.5	27.0	21.0	7.0	14.0	14.7	6.6	8.1
Guizhou	29.5	8.7	20.9	17.8	7.4	10.4	17.2	6.7	10.5
Yunnan	22.4	9.3	13.3	22.4	8.2	14.2	23.9	8.0	15.9
Shaanxi	21.7	8.2	13.5	16.2	7.2	8.9	16.6	6.2	10.5
Gansu	21.0	7.4	13.5	16.5	5.5	11.0	15.7	5.2	10.4
Qinghai	32.0	8.2	23.7	22.3	6.1	16.2	15.9	5.1	10.8
Ningxia	36.3	7.7	28.6	27.4	5.7	21.7	18.6	3.4	14.8
Xinjiang	33.1	8.7	24.4	21.8	7.7	14.1	19.9	6.5	13.4
Total	23.1	7.4	15.8	17.0	6.3	10.6	13.9	5.9	7.9

Table 3.2 (Continued)

Province	1985 CBR	1985 CDR	1985 NIR	1986 CBR	1986 CDR	1986 NIR	1987 CBR	1987 CDR	1987 NIR
Beijing	14.4	5.5	8.9	14.9	4.5	10.4	17.8	6.5	11.3
Tianjin	14.5	5.8	8.8	18.2	6.5	11.6	17.].	6.1	11.0
Hebei	13.4	5.7	7.7	19.8	6.1	13.7	22.5	6.0	16.5
Shanxi	14.2	6.0	8.2	21.3	6.3	15.0	20.1	6.5	13.7
Neimenggu	13.8	4.5	9.3	18.2	5.3	12.9	19.7	6.1	13.6
Liaoning	11.9	5.3	6.6	15.9	5.9	10.0	17.3	5.3	12.0
Jilin	10.7	4.3	6.5	18.9	5.9	13.1	18.2	5.4	12.8
Heilongjiang	10.7	4.3	6.5	16.9	5.5	11.5	19.2	5.2	14.0
Shanghai	12.7	6.7	6.1	11.3	4.6	6.6	15.3	6.7	8.6
Jiangsu	10.8	5.9	5.0	15.7	6.9	8.8	15.4	5.8	9.6
Zhejiang	12.1	6.1	6.1	16.4	6.7	9.6	17.0	6.9	10.1
Anhui	12.8	5.2	7.6	17.9	6.6	11.3	18.9	5.9	13.0
Fujian	17.5	5.4	12.1	18.7	4.7	14.0	21.0	5.8	15.2
Jiangxi	14.3	5.5	8.7	23.3	7.1	16.2	20.4	6.5	13.8
Shandong	11.8	5.9	5.9	21.9	7.1	14.8	23.4	7.1	16.3
Henan	11.5	6.2	5.3	19.7	6.6	13.2	21.8	6.5	15.3
Hubei	13.2	6.7	6.5	22.3	9.2	13.1	21.4	7.1	14.3
Hunan	14.4	6.5	8.0	21.1	5.8	15.3	23.6	7.1	16.6
Guangdong	15.7	5.0	10.7	23.4	6.4	17.0	22.2	5.7	16.4
Guangxi	19.5	5.1	14.4	30.3	6.8	23.5	24.4	7.4	17.1
Hainan	12.8	6.7	6.1	21.3	6.8	14.5	17.9	7.0	10.9
Sichuan	15.0	6.4	8.6	24.1	6.0	18.1	23.7	8.5	15.2
Guizhou	16.8	6.6	10.2	23.7	7.1	16.6	24.0	8.4	15.6
Yunnan	23.3	10.1	13.2	34.9	3.5	31.4	23.9	7.8	16.0
Shaanxi	16.1	6.0	10.1	23.5	5.0	18.4	21.6	6.3	15.3
Gansu	14.3	5.0	9.0	18.7	5.4	13.2	20.6	5.7	14.8
Qinghai	14.2	4.6	9.6	19.3	5.5	13.8	22.6	6.4	16.2
Ningxia	17.1	3.8	13.3	30.2	3.5	26.7	25.1	5.0	20.1
Xinjiang	19.8	6.4	13.4	23.2	7.5	15.7	27.3	8.7	18.6
Total	13.6	5.8	7.8	20.5	6.4	14.1	21.0	6.7	14.4

Sources: NBSC (Department of Population Statistics). 1989. *China Population Statistics Yearbook* 1988

Table 3.3 Provincial Total Fertility Rates in China, 1945-82.

Province	1945-48	1949-58	1959-61	1962-70	1971-78	1979-82
		Total Fertility Rates				
Beijing	5.231	5.580	3.868	4.101	1.908	1.517
Tianjin	5.452	6.887	4.844	4.258	2.172	1.414
Hebei	4.599	5.531	3.671	5.514	3.240	2.614
Shanxi	4.331	5.115	4.501	5.933	3.925	2.366
Neimenggu	4.752	5.731	5.034	5.641	3.785	2.688
Liaoning	4.881	6.289	4.523	5.514	2.721	1.975
Jilin	6.056	6.868	5.737	6.523	3.509	2.140
Heilongjiang	5.280	6.509	5.844	6.188	3.846	2.504
Shanghai	5.255	5.491	3.062	2.755	1.371	1.158
Jiangsu	5.403	5.610	3.642	5.211	2.582	1.810
Zhejiang	5.432	5.933	4.246	5.986	2.982	2.157
Anhui	4.752	5.224	2.254	6.619	4.265	2.926
Fujian	4.781	5.899	4.487	6.594	4.720	2.578
Jiangxi	4.943	5.779	4.463	6.923	5.942	3.313
Shandong	4.838	5.385	3.593	5.607	3.333	2.121
Henan	4.725	5.263	3.156	6.452	4.287	2.707
Hubei	5.444	6.002	4.268	6.633	3.718	2.472
Hunan	5.429	6.079	3.502	6.820	4.052	2.798
Guangdong	4.186	5.163	4.074	5.777	4.297	3.540
Guangxi	4.890	5.602	4.457	6.459	4.892	3.863
Hainan	5.057	5.969	3.007	6.396	4.376	2.194
Sichuan	5.379	6.110	3.794	6.936	5.837	4.227
Guizhou	5.358	6.132	4.222	6.587	5.318	3.688
Yunnan	5.167	5.847	4.637	5.983	3.877	2.523
Shaanxi	5.711	6.106	3.596	6.929	4.507	2.910
Gansu	3.836	4.158	2.157	5.742	5.431	4.620
Qinghai	6.416	6.696	3.581	6.865	5.346	4.190
Ningxia	4.109	5.252	4.686	6.407	5.079	3.646
TOTAL	4.968	5.697	3.883	6.086	3.927	2.611
Highest-Lowest	2.220	2.710	3.687	1.725	3.360	2.810

Sources: Coale and Li. 1987. Pp. 24-189

A process of diffusion in China's fertility transition has been confirmed by empirical research. Skinner (2000), using a 1% sample (12 million records) of households from the People's Republic of China's 1990 population census and geographic information system (GIS), demonstrated that as fertility levels decline overall, the cessation of childbirth with the fourth birth diffused through hierarchical regional space. Because the pace of fertility transition in China has been enforced by the government, it is remarkably compressed in time. In addition, sustained fertility decline started in a few large municipalities and some eastern provinces. Then the transition gradually spread to the interior. The urban fertility transition was much earlier and faster than the rural one. By contrast, the vast area covering northwest and southwest China entered the transition much later, and relatively high fertility in that area has persisted to the present (Peng, 1989).

Freedman and his colleagues (1988), using 1982 One-per-thousand Population Fertility Sampling Survey data, illustrated that age at marriage, abortion ratios, proportion of first births, proportion having a one-child certificate, types of contraception used, and fertility and educational development vary considerably in different local areas (also see Poston and Gu 1987). However, the magnitude of the fertility declines across educational levels strongly suggests that the family planning program has been very effective. It is worth noting, for example, that the fertility of Sichuan, the most populous province, declined spectacularly for a short period and for such a large population from initial high levels across all educational levels. The overall Chinese fertility rates are very responsive to variations in birth control policy regulations. Areas with mainly ethnic minorities or low population densities show higher fertility rates than other areas, all other things equal. This may be partly due to loose policy regulations in these areas (Liu and et al., 1996).

In China, late marriage has long been a principle of the official family planning policy, and it is still vigorously pushed today. Based on the 1982 China National One-per-thousand Population Fertility Sampling Survey, Bianco identifies that it was promoted with little success during the 1960s when the mean age of women at first marriage remained slightly under twenty (19.8 years: Bianco 1985). It increased steadily thereafter until the late seventies from 21.6 years during the 1970s to over 23 years in 1979. While three-fifths of women aged 20 were married in 1970, only one-fourth were married by the same age ten years later. Following the promulgation of a new marriage law in 1980 and the application of the responsibility system in agriculture, rural areas witnessed an increase in early marriages. In 1982, the mean age at first marriage for women was 22.6 years, half a year less than the mean age reached by the late seventies. In 1990, Chinese women who had married before the age of 20 totaled 2.76 million, more than in 1982 when the number was 2.7 million. Nearly 90% of the women who had married early were village women. Women who married early gave birth early. In 1989, the number of early births was 2.5 times higher than in 1980.

Because of ancestral values, the enduring desire for a large family and the strong preference for a son are encouraged among parents eager to perpetuate the family line, especially after the adoption in 1979 of the single-child family policy. Several studies have documented these desires. The strength of the desire for at least one son is underlined by the cases of female infanticide reported by various sources (Bianco 1985). However, there is little evidence today indicating the existence of female infanticide.

Urban-rural differentials in fertility are marked. Prior to 1970, urban fertility was high but was showing a decline; however, rural fertility rates were not only higher, but have remained fairly stable. Beginning in 1971, the gap between urban and rural fertility rates narrowed. In contrast, educational differentials in fertility were even higher than urban-rural differentials (Table 3.4).

Table 3.4 Average Number of Live Births to Women Age 35, 40 or 45 in 1982.

	China	Rural Areas	Urban Areas
All Educational Levels	4.18	4.44	2.92
Illiteracy	4.74	4.78	3.97
Primary School	3.81	3.99	3.14
Junior High	3.08	3.52	2.6
Senior High	2.41	3.17	2.21
College or University	1.94	2.22	1.92

Source: Bianco 1985.

The importance of the family-planning program on fertility transition is a subject of some controversy. While Mauldin (1982) has argued that family-planning programs had a significant, independent effect on fertility, Handwerker (1986) claimed that family-planning services alone could not cause the fertility transitions. To some extent in China, both views are true. Most, but not all, of the fertility decline that took place in mainland China is attributable to the birth control program. Actually, earlier than in Taiwan, birth control was first advocated on the mainland in 1957. The campaign did not last long and was quickly followed by intensive criticisms of Ma Yin-chu, the foremost advocate of population planning. Pro-natalistic slogans such as "one added mouth means two more arms" were spread to denounce Ma's idea. Ma's promotion of birth control was a dismal failure. The second birth control campaign (1962-66) was likewise largely ineffective, except in a few large cities (Aird 1981). It was muted at the outset of the Cultural Revolution and criticized by a barrage of anti-Malthusian proclamations. Without a doubt, these discontinuities and reversals in the official population policy contributed to the disappointingly meager results obtained by 1970 (Bianco 1985).

Saddled with the extreme socioeconomic burden resulting from the second baby boom, China entered the third period of its family policy. Banister (1987) described this as a remarkable period in the history of China's fertility and family planning. In July 1971, the State Council issued its 53rd document asking governments at all levels to continue implementing the population control policy. Two years later, the state's leading family planning body was established as an independent administrative institution to be in charge of all functions related to family planning. on December 31, 1974, the Central Committee of the Chinese Communist Party issued the 32nd document and called for party committees at all levels to put family planning into their working schedules and to further intensify their leadership. This population policy was advanced with the objectives of controlling population growth in conformity with the guiding requirements of "Wan-Xi-Shao" (Later-Longer-and-Fewer) and of extending the policy to rural and ethnic areas. The "Fewer" policy not only slowed China's population growth in the 1970s, but also obviously changed traditional Chinese fertility behavior, which was useful preparation for the later implementation of the one-child policy (Ye 1991; Xie 2000).

The demographic pressure from the second baby boom began to hamper the nation's socioeconomic development. This serious reality finally forced Chinese authorities to adopt a one-child policy in 1979. This policy was claimed as the state's policy at the Chinese Communist Party's twelfth convention on September 1, 1982, and legalized by including it in the Constitution of the People's Republic of China passed on December 4, 1982. The specific requirements of this policy included late marriage, late childbearing, few births, and better babies. The basic components are as follows: (1) strongly encouraging couples to have only one child, (2) seriously controlling second births, and (3) absolutely stopping higher parities. The third requirement is rigorously applied throughout the country except in some of the less populous ethnic areas. For the second requirement, the state has not established national rules about how to control second births. The central government has assigned rights to individual provinces, municipalities and autonomous regions to make decisions in terms of local circumstances (Ye 1991; Wu 1997).

In part because of the one-child policy’s demographic success and in part because of the political problems that stemmed from efforts to shrink family size very rapidly, in 1984 and 1985 China's leaders took steps to relax the birth-planning policies. An important shift in policy direction occurred in April 1984 with the issuance by the Party's Central Committee of Central Document 7. Under this document, the conditions under which couples may have two children were expanded and reforms were called for in policy, work style, organization, and ideology that were designed to increase voluntary participation through better meshing of the policy with the needs of the people. In 1986, however, in response to the concern that age structure would put upward pressure on the birthrate for the coming decade, Document 13 put more restrictive measures on the one-child limitation (Greenhalgh 1986). In addition, economic reforms undermined the enforcement of China’s state-directed birth planning program. The disbanding of the socialist collectives led to an erosion of cadre power and a breakdown of the system of economic incentives and disincentives on which policy enforcement had been largely based (Greenhalgh et al. 1994). In May 1991, the Central Committee of the Communist Party and State Council issued the “Decision on Strengthening Birth Planning Work and Strictly Controlling Population Growth” to guarantee policy stability and enhance efforts to implement the policy (especially in the rural areas) by mobilizing the entire party and society. Following this decision, in order to elevate the achievement of population goals to a level equal that of economic goals, a new system was introduced that placed responsibility for birth control in the hands of the provincial governor and party secretary.

In China, industrialization and urbanization have been neither fast nor vast. China’s great success in family planning (Table 3.5) is largely attributed to the well organized implementation of the designated policy. In essence, the central government launches the targets and policy directives. Targets are then allocated to the provinces and counties. Birth-planning committees at these levels are responsible for devising the actual policies that will guide fertility behavior within their boundaries on the basis of results from local sources at the provincial and county levels.

Table 3.5 Family Planning Achievements in China, 1979-1988.

Area	Year	Rate of Late Marriage (Female)	Contra-ceptive Rate	Rate of One Parity	Rate of High Parity* Received	Rate of One Child Certificate
Total China	1979	86.00	79.80	--	--	39.10
	1980	87.50	82.00	--	--	57.10
	1981	68.73	88.90	57.70	16.70	60.04
	1982	64.89	89.60	61.21	15.14	66.77
	1983	81.30	92.00	65.90	11.70	71.80
	1984	58.86	85.82	68.03	10.29	18.25
	1985	55.20	85.80	67.66	8.45	18.14
	1986	54.12	85.61	65.81	7.28	17.90
	1987	--	--	49.31	18.20	--
	1988	56.30	87.90	--	--	18.20
Urban China	1979	93.70	87.20	--	--	64.00
	1980	95.10	88.20	--	--	82.90
	1981	80.00	94.10	80.84	5.98	86.61
	1982	80.48	94.70	83.76	5.19	90.79
	1983	81.30	95.50	83.00	4.70	88.00
	1984	73.08	86.86	84.30	3.67	34.46
	1985	67.05	87.79	82.74	3.11	35.11
	1986	66.68	87.60	79.59	3.08	34.70
	1987	--	--	70.89	8.90	--
	1988	62.40	88.90	--	--	27.80
Rural China	1979	82.70	78.70	--	--	34.60
	1980	84.90	81.00	--	--	51.00
	1981	65.58	88.00	54.70	18.14	52.87
	1982	60.98	88.70	57.70	16.69	59.02
	1983	61.10	91.20	62.30	13.20	65.20
	1984	53.20	85.29	63.31	12.25	12.87
	1985	49.42	84.89	62.87	10.19	11.82
	1986	47.78	84.58	60.82	8.96	11.12
	1987	--	--	43.93	21.29	--
	1988	48.90	87.10	--	--	10.00

Sources: *CFPYEC 1990. Yearbook of China Family Planning.* Pp. 374-431

There are four major measures taken by the Chinese government to carry out its population control policy. These are:

1. A network of family planning organizations. By the end of 1985, China had 29 provincial; 2,427 district, city, and county; and 62,030 village and town family planning commissions and offices (CFPYEC 1986). In 1993, there were 900,000 branch associations throughout the country under the China Family-Planning Association, with more than 50 million members assisting the implementation of the family-planning program (Xie 2000). All of these commissions or offices have been designated to be in charge of family planning in their own administrative areas under the dual direction of the local government and the State's Family Planning Commission (Ye 1991).

2. State Financial Support. In 1982, local government expenditures constituted 83.4% of the total expenditures of family planning. The state's financial aid is primarily used to supply free contraceptive materials and services for the public, pay salaries for family planning personnel in local commissions, and support scientific research in family planning (CFPYEC 1986).

3. Family planning dissemination and contraceptive services. The most significant developments in family dissemination have occurred during the last two decades. With mass media, face-to-face family planning propaganda, an intensive "family planning month" each year, and instructive courses in schools, clear goals help the public understand why and how to practice family planning so that they will change their traditional fertility behavior and implement population control policy voluntarily (Sun 1987; CFPYEC 1986).

4. Incentive and disincentive systems. The system focuses on offering political and social rewards and economic support to couples who voluntarily give birth to only one child during their reproductive lives. The major family planning rewards include: educational benefits for the child; medical care, employment, housing, and a certain amount of health allowances; benefits for parents such as having more days off for weddings and childbearing, achieving relatively higher retirement stipends in urban areas, and enjoying free services in retirement homes in rural areas. To discourage couples from having extra children, compensation fees are generally required for unplanned fertility behavior. Local governments, institutions, and enterprises are also responsible for the implementation of these measures (Ye 1991; CFPYEC 1986).

Greenhalgh and her associates (1994) clearly documented that, beginning in the late 1980s, the province of Shaanxi strengthened its family program by increasing administrative personnel, investing more funds for incentives, creating party-led birth planning associations, strengthening responsibility systems, making semiannual gynecological exams mandatory, and conducting frequent sterilization campaigns, offering old-age insurance plans for two-daughter couples, and linking to compliance a family’s access to crucial land resources. As a result, the troubles that hindered the accomplishment of the one-child policy in the mid-1980s appear to have been effectively eased in this relatively poor province in a poor region of China.

Has China's strict one-child policy been successful in changing fertility preferences? In the 1970s, rural couples wanted two sons and a daughter (Parish and Whyte 1978). In their review of surveys conducted in rural and suburban areas of nine

Chinese provinces between 1982 and 1985, Whyte and Gu (1987) found that a two-child family (one boy, one girl) was the most common preference. Choe and Tsuya (1991) analyzed a 1985 survey of rural Jilin and found that female respondents reported a mean ideal number of children of 1.95, as reported by Remez (1991). Merli and Smith (2002) argue that the acceptance of policy-sanctioned family size follows a development gradient and reflects the degree of enforcement. High acceptance occurs in the most urban, industrialized counties and in the counties with the most rigid family planning policies. Acceptance is weaker among women living in the poorest counties and in the counties where enforcement is most relaxed.

From anthropological and demographic inquiries, Zhang (1999) documented several changes in fertility behaviors. Zhang discovered that early age at marriage does not necessarily increase fertility. Rural couples prefer to have fewer children, and their motivation to have girls has increased as well. These decisions may be related to several socioeconomic factors. The education of children is more costly. Having more children as a strategy to gain a bigger share of contracted land is impractical because of the abolishment of the ration system after 1987 when land was last adjusted. Parents seem to have less influence on the younger generation. The burden of new housing and modern electrical appliances as a dowry for sons is increasing. Greenhalgh and her associates (1994) also have recorded similar motivations regarding fertility among the people of Shaanxi.

There have been demographic and socio-economic changes that have contributed enormously to fertility decline in China. Notably, the decline in the infant mortality rate

(IMR) has been dramatic since World War II. Infant mortality has dropped tremendously over the last four decades (Table 3.6) with the greatest reduction in the 1950s and 1960s. By the early 1970s, the IMR was only about one-fourth of the level before 1949. During the 1980s and 1990s, the IMR continued to decline at a much slower rate.

Table 3.6 Infant Mortality Rate, 1944-1987 (per 1,000 live births).

Year	IMR	Year	IMR	Year	IMR
1944-49	203.6	1970	51.95	1983	41.37
1950	197.93	1975	48.05	1984	38.41
1955	107.64	1980	42.76	1985	37.38
1960	109.92	1981	37.33	1986	37.14
1965	72.13	1982	36.42	1987	39.92

Source: Yao and Yin 1994, p.145.

As for the rise in life expectancy at birth, China rose from a little over 40 years in 1950 to almost 71 years in 1981, an increase by an average of one year every year (Table 3.7). During the same period of time, few developing countries gained in life expectancy more than one year every two years (Coale 1984).

Freedman (1997, pp.10-11) concludes that there is evidence to suggest that "family planning programs sometimes do not affect couples' preferences, but do help to shape up latent demands created not by the program but by other development processes."

Table 3.7 Life Expectancy by Residence, 1981 and 1989-1990.

Residence	1981			1989-1990		
	Males	Females	Both Sexes	Males	Females	Both Sexes
City	69.08	72.74	70.87	70.7	75.05	72.77
County	65.56	68.36	66.95	67.59	70.91	69.18

Source: Huang and Liu 1995. Pp. 27-56.

Taiwan

The demographic transition in Taiwan gained momentum after World War II (Freedman et al. 1963; Chang et al. 1981). The dramatic decline in the mortality rate took place shortly after World War II, dropping from 18 per thousand in 1947 to 8 per thousand in 1956, and to less than 5 per thousand in 1970. A continuous decline in the birth rate began in the late 1950s. In 1955, the total fertility rate (TFR) was 6.5 and the net reproduction rate (NRR) was 2.8. The crude birth rate was 45.3 per thousand. A decline in fertility proceeded rather slowly until the mid-sixties. In 1960, the TFR was 5.8, and the natural increase rate was 36.7 per thousand (Table 3.8). It accelerated throughout the succeeding decade (1965-1975), and then leveled off. In 1983, the NRR fell to 1.0 and to 0.9 in 1985. Over the period of 1961-1980, total fertility in Taiwan fell from 5.6 per woman to 2.5, a decrease of 55 percent. At ages over 30, the declines have ranged from 70 to 92 percent. Indeed, nearly two-thirds of the overall fertility decline is attributable to reductions in fertility among women aged 30 and over; this is almost entirely due to marital fertility (Chang et al. 1981, 1987). The result of the almost continuous fertility decline is striking: the TFR has fallen by almost two-thirds in less than thirty years.

During the demographic transition, a diffusion process took place in which the decline in fertility moved from the cities to rural areas, and from the better educated to the less educated couples (Montgomery and Casterline 1993; Sun and Ting 1988). The diffusion process was so rapid during the late sixties and early seventies that the increase in the use of contraception was greater in lower status than in higher status categories. By 1980, the educational differentials in contraceptive use had almost vanished. In 1973, urban-rural differentials still existed but rural townships reached fertility levels prevailing in the cities three years earlier. In 1975 they reached fertility levels prevailing in Taiwan as a whole two or three years earlier and in Taipei five years earlier (Sun and Ting 1988). In 1991, the TFR was 1.94 for rural townships, 1.84 for urban ones and 1.54 for Taipei (Freedman et al. 1994).

In 1943, the mean age of Taiwanese women at first marriage was 20.8 years. By 1980, mean age at marriage rose slightly, by three years to 23.8 years (Liu and Sun 1979; Sun 1983). Higher age at first marriage has nevertheless progressed at a rapid pace in Taiwan. While three-fifths of Taiwanese women aged 20-24 were married in 1961, the proportion fell to one half in 1970 and a little over two-fifths in 1976. For women aged 15-19, the proportion fell from one in eight in 1961 to one in eighteen in 1976 (Sun et al. 1978). The rapid changes were achieved in spite of the rather long persistence of traditional Chinese values favoring large families. The adherence to these values is

Table 3.8 Population Size and Vital Rates of Taiwan, 1950-2002.

Year	Total Fertility Rate	CBR	CDR	NIR
1950	6,030	43.40	11.47	31.93
1951	7,040	50.00	11.57	38.43
1952	6,615	46.60	9.88	36.72
1953	6,470	45.20	9.43	35.77
1954	6,425	44.60	8.17	36.43
1955	6,530	45.30	8.59	36.71
1956	6,505	44.80	8.02	36.78
1957	6,000	41.40	8.46	32.94
1958	6,055	41.70	7.58	34.12
1959	5,990	41.20	7.23	33.97
1960	5,750	39.50	6.95	32.55
1961	5,585	38.30	6.62	31.68
1962	5,465	37.40	6.33	31.07
1963	5,350	36.30	6.03	30.27
1964	5,100	33.95	5.70	28.25
1965	4,825	32.70	5.50	27.20
1966	4,815	31.88	5.36	26.52
1967	4,220	28.01	5.38	22.63
1968	4,325	28.81	5.38	23.43
1969	4,120	27.72	5.00	22.72
1970	4,000	27.18	4.91	22.27
1971	3,705	25.64	4.78	20.86
1972	3,365	24.15	4.72	19.43
1973	3,210	23.79	4.76	19.03
1974	3,045	23.42	4.76	18.66
1975	2,830	22.98	4.69	18.29
1976	3,075	25.93	4.69	21.24
1977	2,700	23.76	4.76	19.00
1978	2,710	24.11	4.68	19.43
1979	2,660	24.41	4.73	19.68
1980	2,515	23.38	4.76	18.62
1981	2,455	22.97	4.84	18.13
1982	2,320	22.08	4.77	17.31
1983	2,170	20.56	4.88	15.68
1984	2,055	19.60	4.75	14.85
1985	1,880	18.04	4.81	13.23
1986	1,680	15.93	4.9	11.03
1987	1,700	16.01	4.91	11.10
1988	1,855	17.24	5.15	12.09
1989	1,680	15.72	5.15	10.57
1990	1,810	16.55	5.21	11.34

Table 3.8 (Continued)

Year	Total Fertility Rate	CBR	CDR	NIR
1991	1,720	15.70	5.18	10.52
1992	1,730	15.53	5.34	10.19
1993	1,760	15.58	5.31	10.27
1994	1,755	15.31	5.4	9.91
1995	1,775	15.50	5.6	9.90
1996	1,760	15.18	5.71	9.47
1997	1,770	15.07	5.59	9.48
1998	1,465	12.43	5.64	6.79
1999	1,555	12.89	5.73	7.16
2000	1,680	13.76	5.68	8.08
2001	1,400	11.65	5.71	5.94
2002	1,340	11.02	5.73	5.29

Sources: EYRC. 2002. *Statistical Yearbook of the Republic of China 2002*

clearly documented in Taiwan, where KAP (Knowledge, Attitude, and Practice) surveys have been conducted (Weinstein et al. 1990; Freedman et al. 1994).

The preferred number of children remained quite high in Taiwan until 1970: the overall average number of children desired by married women aged 22-39 was 4.2 in 1965, 3.8 between 1965 and 1970, 3.2 by 1973, 3.0 by 1980, 2.7 by 1985 and 2.5 by 1991 (Freedman et al. 1994). Traditional attitudes persisted in slowing further progress in practicing birth control. For example, most Taiwanese couples used contraception in order to terminate childbearing (once they had all the children they wanted), not for spacing purposes. During that initial period (prior to 1970), very few younger and low parity wives used contraception in order to space their children.

The strong preference for sons persisted much longer than the desire for a large family. According to the 1973 KAP survey, one daughter was considered enough by three-fifths (59 percent) of the respondents, while only one-sixth (17 percent) were satisfied with one son (Freedman et a. 1974). Among couples with three children in 1976, only one-half (49 percent) of those with no sons practiced contraception, while five-sixths (83 percent) of those with two or three sons were using contraception (Sun et al. 1978). In the 1991 KAP, this phenomenon still existed (Freedman et al. 1994). Poston et al. (1997) found that cities have the highest median sex ratio at birth, followed by towns and then villages; nevertheless, each median was higher than biologically normal.

Taiwan has had large developmental changes over the last thirty years, many of which are generally believed to be conducive to fertility decline (refer to Table 3.9). These include: increases in income while equality of income distribution was maintained (Ranis 1992); shifts from agriculture to industry and other sectors of a modern economy; rises in educational levels with increasing equity for women; expansion of the mass media and of facilities for communication and transportation; the blurred disparity of urban and rural areas; and major advances in health services and life expectancy. In 1952, life expectancy at birth was 59 and increased to 74 in 1991. The decline in the infant mortality rate has been impressive since World War II. By 1952, the infant mortality rate no longer exceeded 45 per thousand. It further declined to 20 by 1969 and to 10 per thousand by 1981.

The resources and infrastructure created by these developmental changes have facilitated Taiwan's effective family planning program, which has, in large measure,

Table 3.9 Socioeconomic Development Indicators of Taiwan 1955-1985.

Year	College Education (%)	Illiteracy Rate (%)	Per Capita Income (US Dollar)	Industrial Employed Population (%)	Infant Mortality Rate (0/00)
1955	1.65	37.92	--	12.46	36.90
1956	1.66	37.12	--	13.16	36.89
1957	1.78	32.27	--	13.02	37.32
1958	1.78	30.94	--	12.86	39.92
1959	1.82	28.91	122	12.76	35.86
1960	1.89	27.10	143	15.54	32.43
1961	1.95	25.87	142	15.87	32.70
1962	2.02	24.81	151	--	31.27
1963	2.17	24.30	166	20.85	28.43
1964	2.27	22.47	189	22.07	25.53
1965	2.32	23.12	203	22.30	23.67
1966	2.47	23.16	221	23.40	22.10
1967	2.97	19.56	249	25.10	21.14
1968	4.68	23.66	283	24.90	21.34
1969	4.91	21.59	320	26.40	19.46
1970	5.23	20.58	360	28.30	17.41
1971	5.68	19.42	410	30.30	15.96
1972	6.10	18.35	482	32.10	16.40
1973	6.01	17.31	642	34.00	16.21
1974	6.49	16.59	852	24.50	14.08
1975	6.69	15.70	888	35.50	13.86
1976	7.41	14.90	1039	36.40	12.88
1977	7.87	14.15	1189	37.60	12.40
1978	8.46	13.44	1437	39.30	11.30
1979	8.78	12.79	1748	41.80	10.98
1980	9.08	12.21	2140	42.40	11.02
1981	9.56	11.52	2424	42.20	10.05
1982	10.08	11.03	2382	41.20	8.99
1983	10.50	10.54	2515	41.10	8.34
1984	10.94	10.05	2794	42.30	7.53
1985	9.38	9.60	2868	--	7.37

Source: EYRC 1985b. *Statistical Yearbook of the Republic of China 1985.*

provided the contraceptive services that were the immediate major determinants of the decline in marital fertility. Table 3.10 shows that married women increased their practice of contraception from 1965 to 1991. After 1980, younger married women practiced contraception to the same degree as the older cohorts.

Table 3.10 Percent of Married Women Aged 20-39 Who Have Ever Practiced and Currently Practice Contraception, Taiwan, 1965-1985.

Age Group	1965	1970	1976	1980	1985	1991
Ever Practiced Contraception						
20-21	5	NA	33	54	68	68
22-24	5	18	45	59	80	81
25-29	20	41	72	78	89	87
30-34	35	69	86	89	94	93
35-39	41	74	89	92	92	94
Total: 20-39	27	51	65	79	90	91
Currently Practicing Contraception						
20-21	3	NA	19	37	51	49
22-24	4	13	28	41	61	60
25-29	17	30	55	64	72	69
30-34	31	55	76	78	85	83
35-39	36	63	79	84	86	88
Total: 20-39	24	43	51	66	78	80

Source: Freedman et al. 1994.

The Taiwan government maintained a generally pro-natalistic attitude during the 1950s. In spite of gradual changes during the 1960s, the government waited until 1968 before giving official sanction, as well as a larger scope and a new impetus, to a program which developed independently. At the least, it did not discourage private initiatives, and transitions have been smooth from the pioneering private efforts to the official anti-natalist policy, which has not been abandoned since its adoption in 1968.

A small "pre-pregnancy health program" started by the Provincial Health Department in 1959 was expanded in 1963 to cover one-third of the island's 361 townships. A large-scale private experiment conducted in Taichung evolved from 1963 on the way to an island-wide program (Freedman, Takeshita, et al. 1969). This expanded FPP (Family Planning Program) started in 1964 and by the end of the 1960s, impressive progress had been achieved in terms of contraceptive use. Between 1964 and 1970, about one-third of all married women aged 20-44 had a first IUD insertion, and their fertility declined accordingly. As the fertility of non-users decreased as well, although at a slower pace, Taiwan's TFR fell by 29 percent during the decade. By 1977, almost one half (49 percent) of Taiwanese women aged 20-24 who married between 1964 and 1977 had an IUD inserted under the auspices of the program. The TFR further decreased by 29 percent between 1970 and 1975 (from 4,000 to 2,830), as much in that five-year span as during the preceding nine years (1961-1970) (Sun 1976; Sun et al. 1978; Freedman et al. 1980).

Without doubt, the Taiwanese Family program provided timely and sufficient contraceptive help to stop unwanted fertility and to merge actual and desired fertility. However, it is argued that the contribution of the program to the overall fertility decline has been much less important than has been the influence of rapid socioeconomic changes (Li 1973). Kingsly Davis succinctly concludes (Davis 1967:736): “In sum, the widely acclaimed family-planning program in Taiwan may, at most, have somewhat speeded the later phase of fertility decline which would have occurred anyway because of modernization.” Sun (2001, p. 86) assesses the role of family planning in Taiwan: “It could be fair to say that Taiwan would have completed its demographic transition even without a family planning program, but it would have taken a much longer period of time. The family planning program contributed to the social and economic development by shortening the process.”

Table 3.11 shows data from Jia (1989) that compares family planning programs in Taiwan and China in terms of family planning practices. Taiwan clearly has had all the necessary and sufficient elements for such demographic change so its fertility transition is voluntary and less traumatic, but has resulted in more lasting changes. China's enforced and well-organized style is impressive and stands contrary to Notestein's statement made in 1950s that family planning was more likely to bring governments than fertility down (Caldwell 1993).

However, because family planning programs are conducted within modernization background and a wide-ranging socioeconomic development, it is understandable that their effects on fertility should be inclined to correspond with the effects of the modernization and development influences. Blake (1973) noted that social and economic structures and institutions tend to influence reproductive motivation and fertility by specifying the reward structures related with childbearing. Kelly and his colleagues argued that "the motivating effect of development on fertility should be mediated by more proximate variables" (1983, p. 92) such as family planning behaviors. Among the Chinese sub-regions, levels of female status are positively associated with levels of contraceptive behavior, which are in turn negatively associated with fertility levels (Poston and Gu 1987). Pritchett (1994a) concluded about reducing fertility that improving economic and social conditions, especially for women will be more promising than contraceptive supply, even though he acknowledged a small effect of family planning programs is intuitively reasonable (1994b). When Gertler and Molyneaux (1994) discussed the reduced Indonesian fertility, they inferred that educational and economic factors, provided with an adequate contraceptive delivery system, can contribute dramatically to increased contraceptive use, and hence to fertility declines. Hirschman (1994) pointed out that family planning programs are disproportionately located in countries where social and economic conditions are already favorable for fertility declines. Schultz (1993), using 204 country-years from 68 countries, deduced that increasing women's education is the best indicator for reducing fertility, while family planning does not have a significant effect.

Nortman (1985, p. 782) has noted that there is an important synergistic association between development and family planning variables and the "facilitating role of family planning programs in providing access to modern contraceptives." Since family planning efforts are "part and parcel of mutually reinforcing socioeconomic development policies and projects" (Nortman 1985, p. 781)

From Birdsall and Jamison's (1983) confirmation of lower fertility in higher-income regions of China, Poston and Gu's (1987) empirical analysis of Chinese fertility and regional development, to Poston's (1998) comparison of fertility transition of Taiwan and China, they all endorse Tien's conclusion about the fertility transition of China that the "induced fertility transition of the recent past certainly deserves to be acclaimed as a population planning success sui generis, but its results up to now cannot, and as the present findings suggest should not, be divorced from socioeconomic change, both in the past and the present" (1984, p. 400).

Table 3.11 Similarities and Differences in Family Planning Programs between China and Taiwan.

Indicators	Mainland China	Taiwan
1) Individual Approaches		
Flies	Yes	Yes
Telephone Service	Yes	Yes
Newsletter	Yes	Yes
2) Mass Communication		
TV	Yes	Yes
Radio	Yes	Yes
Newspapers	Yes	Yes
Magazines	Yes	Yes
Mobile Film Shows	Yes	Yes
3) Special Activities		
Propaganda Month	Yes	Yes
Work Group	Yes	Yes
Visitors	Yes	Yes
4) Training Program		
Field Workers	Yes	Yes
Physicians and Nurses	Yes	Yes
Stuff Seminars	Yes	Yes
Population Education	Yes	Yes
5) Population Research		
Members	Yes	Yes
Institutions	Yes	Yes
6) Health Service	Yes	Yes
7) Depots	Yes	Yes
8) Private Sectors	No	Yes
9) Family Planning Network	Complete	NO
10) Government efforts	Strong	Weak
11) Punishment Policy	Yes	No

Source: Jia 1989

CHAPTER IV

THEORIES OF WOMEN'S STATUS AND FERTILITY

The link between fertility and women's status in society is part of most contemporary theories of fertility decline (e.g., Cain 1984; Caldwell 1980, 1982; Handwerker 1986, 1989, 1991; Mason 1984; van de Walle and Foster 1990). For example, improved status of women is hypothesized to result from increased educational (Caldwell 1982) and economic opportunities (Handwerker 1991), leading to increased contraceptive use and declines in fertility.

Although Caldwell rarely focuses directly on women, he implies that changes in women's status are central to the process of fertility decline (1982, p. 323). For instance, he discusses the "patriarchal family head" (1982, p. 301). The patriarch in pre-transitional societies is the decision-maker both in the household and in the larger community, manipulating relationships in a system that rewards both age and maleness (pp. 311, 317). In pre-transitional societies both men and women benefit from high fertility. Low fertility, on the other hand, is associated with a more egalitarian family structure (pp. 320, 322) in which women participate more in financial matters (pp. 320, 322) and, by looking out for their own interests as well as the educational and economic interests of their children, serve effectively to breakdown the rigid traditional family value system that supports high fertility (pp. 317-324).

In contrast to Caldwell's viewpoint, Handwerker (1986, 1989, 1991) argues that women begin to reduce fertility when they can attain adult status, prestige, and wealth by means other than having children. In Handwerker's view, fertility decline results from "changes in opportunity structure that increasingly reward educationally acquired skills and perspectives" (1986, p. 42). Such opportunities arguably are more available to educated women.

According to Dixon-Mueller (1993) Education for women can indirectly decrease fertility in three ways. First, increasing the number of years that women are in school delays marriage and reduces the time duration that women are exposed to the possibility of conception. Second, education creates aspirations for a higher standard of living, thereby decreasing the number of children desired in a family. Education exposes women to "knowledge, attitudes, and practices favorable to birth control" that would enable them to have fewer children. Third, increased labor force participation gives women "alternative sources of social identity and economic support . . . [thereby reducing] women's dependence on men and children" (Dixon-Mueller 1993, pp. 121-123).

A connection between women's status and fertility in a cross-sectional analysis of India was established by Dyson and Moor (1983). They introduced the concept of female autonomy. Female autonomy, they said, is "the capacity to manipulate one's personal environment and the ability--technical, social and psychological--to obtain information and to use it as the basis for making decisions about one's private concerns and those of one's intimates" (Dyson and Moor 1983, p. 250).

Compared with women in northern India, women in southern India have both relatively greater autonomy and fewer children. Dyson and Moore explain this correlation by proposing that men and women have different reproductive goals, and that women in southern India have greater autonomy (freedom to act according to their own needs), so they curtail the number of children they have.

Another potential link between gender inequality and fertility, Cain (1984, p. 14) posits, “operates through security needs and the premium on sons that derives from women's position of economic dependence.” In contrast to Dyson and Moore, Cain (1984) suggests that the reproductive goals of men and women are not always different and fertility rates may be consistently high because of abiding insecurity and because of the preference for sons that the insecurity entails. His analysis also established a negative relationship between fertility rates and higher status of women across 21 countries (Cain, 1984, p. 42).

Poston and Gu (1987) found, however, that an index of women’s status did not correlate significantly with fertility rates in China (circa 1982), but did have significant indirect effects on fertility through family planning. The index Poston and Gu used consisted of three indicators: female life expectancy at birth, percentage of the female population that is literate, and percentage of females engaged in non-agricultural labor. Cleland (1996), as well, questions the connection between the social position of women and fertility decline.

Nevertheless, while it is generally recognized that women's status does not necessarily change uniformly along a single dimension (Mason 1984; Whyte 1978), theoretical models of the relationship between women's status and fertility generally posit a strong negative relationship between the two.

Women's status is no doubt a multidimensional concept, and each aspect has a different association with fertility behavior. For research feasibility, however, the concept must be defined operationally. In this dissertation, therefore, the concept of woman's status will refer to her employment situation and educational level. That is, education and employment will be separately examined to ascertain any relationship with fertility behavior.

In the remainder of this chapter, the literature about influences of education and employment on fertility is reviewed more fully.

Education and Fertility

Among the socio-economic variables that have been studied in relation to demographic transition, women's education is perhaps the variable most widely accepted for operationally defining the status of women. For example, particular concern for women's empowerment was evident in the International Conference on Population and Development (ICPD), held in Cairo in 1994. The Conference stressed that "beyond the achievement of the goal of universal primary education in all countries before the year 2015, all countries are urged to ensure the widest and earliest possible access by girls and women to secondary and higher levels of education" (United Nations 1995a).

Further, many studies consider women's education an indicator of status that is a crucial factor in fertility decline. That is, high status is associated with low levels of fertility (Cochrane 1979 and Mason 1984). Researchers have pointed out that improvement in female education is associated with: (1) more opportunities for outside employment; (2) increased aspirations for upward mobility, including a greater urge to educate one's children; (3) more participation in decision-making; and (4) greater opportunity to interact with the outside world and acquire information through exposure to various media. All these aspects seem associated with the emergence of the small-family norm. What, however, exactly constitutes the status and how it influences fertility is still subject to debate (Mason 1986; Jeffery and Basu 1996).

As mentioned previously, education plays an important role in improving female autonomy (Dyson and Moore 1983). In the context of the impact of female autonomy on fertility, autonomy has been split into five categories (Jejeebhoy 1995): (1) knowledge autonomy--enhancement of women's knowledge through exposure to the outside world, (2) decision-making autonomy--strengthening of women's participation in family decisions concerning their lives and well-being, (3) physical autonomy in interacting with the outside world--fewer social and familial constraints on physical mobility, increased self-confidence and the ability to extract the most from available services, (4) emotional autonomy--a shift of women's loyalties from extended kin to the conjugal family, and often associated with greater intimacy between spouses and between parents and children, and (5) economic and social autonomy--enhancement of self-reliance in economic matters, increased access to and control over economic resources, and increased reliance on one's own ability to achieve social acceptance and status. Women's education interacts with each of these aspects and ultimately leads to greater autonomy.

The degree of women's autonomy is also, however, affected by cultural factors. Whether educated women can enjoy all types of autonomy within every culture has not been established. At the same time, even women who have little education may, in an egalitarian environment, achieve greater autonomy by offering services that earn income.

Available fertility theories postulate various linkages between education and fertility. A framework widely used in this context is the one suggested by Easterlin (1975). It provides a convenient and sensible model for synthesizing the proposed linkages. According to the framework, all intervening factors influencing fertility can be classified as (1) supply, (2) demand and (3) cost of fertility regulation. The *supply* of children is the number of surviving children a couple would have in the absence of fertility regulation. It takes into account both natural fertility and the mortality rate among children. The *demand* for children refers to the desire (preference) for a certain number of children. Various social, economic and cultural contexts shape the preference for children, for example, religious doctrines, moral codes, laws, education, customs, marriage habits and family organizations. This constellation of contextual determinants, in conjunction with consideration of the benefits and costs of having children, gives rise to the parents' demand for children (Becker 1960). The *cost of fertility regulation* encompasses not only the economic costs of regulation, but also the social and the psychological costs.

All three components--supply, demand and cost of fertility regulation--are important in shaping the ultimate fertility behavior of a population. When the *supply* of children exceeds the *demand*, which is generally true in most populations today, the demand for and *cost of fertility regulation* assumes greater importance in affecting the ultimate fertility behavior. The relative role of supply and demand in engineering fertility decline is, however, still being debated.

The extant studies relating education and fertility show that the relationship is not precisely understood. on one hand, mothers' total years of schooling has a strong negative correlation both with the birth rate at the macro level and with family size at the micro level (Lal 1968; Kirk 1971; Schultz 1972; Farooq and Tuncer 1974; Heller 1976; and Cochrane 1978). on the other hand, at higher levels of education, either no relationship or a positive relationship is seen between total years of education and birth rate or family size (Graff 1979; Cochrane 1979). In a few groups with higher levels of socio-economic development and extremely advanced education, fertility tended to increase along with a woman's education. Jejeebhoy (1995) has identified three distinct patterns of variation between women's education and fertility. She has labeled them (1)the reversed 'U', and (2) the reversed 'J' and (3) the'7'. The reversed-U pattern is characterized by peak fertility for women with a small amount of education, higher than the education of illiterate women. The reversed-J shape relationship is observed where highly educated women end up with lower fertility than uneducated women. In both these patterns, the reversed-U shape and reversed-J shape, the least- and best-educated women show lower fertility than women with moderate educations. In a 7-shaped relationship, fertility remains practically unchanged until the woman attains a certain minimum level of education, then and starts declining once she crosses the threshold.

Cochrane (1979, p.6) mentioned: “In general, the evidence of an inverse relation between education and fertility in aggregate data is strongest for countries at the middle level of development.” Some others have contended that the negative relationship is likely to be strong in relatively developed areas and weak or absent in less developed areas (Jeerebhoy 1995; United Nations 1995b). In other words, the relationship between women's education and their fertility is not yet conclusive. According to Le Vine and others (1991), "The robust and widespread association found between women’s schooling and demographic variables are at once extremely familiar and persistently ambiguous . . . yet it has not adequately identified the intervening pathways or processes through which they are connected within any particular population, let alone the variability of the processes across populations past and present.” Several researchers have raised doubt about whether the education of women can be considered a causal factor affecting fertility, emphasizing that it works only indirectly. In other words, the strength of the relationship will depend on occupation, age at marriage, and so forth. (Radha Devi 1988). Similarly, arguably the strength of the relationship will depend on the extent to which education facilitates empowerment in terms of greater autonomy, media exposure and other factors. The available studies suggest that the degree to which fertility behavior may be modified through education in one population as opposed to another will be affected by the socio-cultural environment in which the women live (Radha Devi 1997). Therefore, the relationship between education and fertility is a subject that calls for more thorough investigation, especially contextual analysis.

Among empirical studies in Taiwan and China, most generally have no findings to contradict the negative effects of women's education on declining fertility. Li and Choe (1995), using a hazard model combining logistic regression to analyze 1988 Two-per-Thousand National Fertility Survey, state that a higher educational level is associated with a lower probability of a second birth in China. Zhang (1990) found a nonlinear J-shaped relationship between education and fertility in the 1985 Comprehensive Fertility Survey in Hebei, Shaanxi and Shanghai. That is, over the age interval of 23-34 years, fertility is relatively high for women with either no schooling or primary education, lowest for those with secondary-school education, and highest for those with a high-school education. Schultz and Zeng (1995), focusing on rural fertility in China, found in a sample aged 15 to 34 that a woman with four more years of education than the average is expected to have two-tenths fewer children. on the other hand, women with that extent of education in an older sample aged 35 to 49 had displayed an even greater decrease in fertility.

Using a time-series approach in Taiwan, however, Cheng and Nwachukwu (1997) failed to establish the existence of any relationship between fertility and education. Cheng (1999) found that education has a great influence on female labor participation, but not on fertility. He believes that little formal education has not had a negative impact because of the wide dissemination of contraceptive information and the successful promotion of family planning on the island. Freedman and his associates (1988) report a negative relationship in rural China between fertility and education, both in macro-level production brigades and on a personal level. They also note, however, that effective family planning programs in China have resulted in a decrease in differences across educational levels in certain provinces after the 1970s. In this dissertation, I will empirically examine the effects of women's educational status on fertility and contraceptive behavior of women in Taiwan and China. Further, the main focus of my multilevel analysis will be to see how the individual-education variable mediates between the influence of macro-level variables and personal fertility activities in China and Taiwan. The direct and indirect effects of macro-level female educational attainment on personal fertility decisions will be discussed in Chapter VI.

Employment and Fertility

The relationship between female employment and fertility continues to attract the attention of researchers in both developed and less developed countries (LDC). How labor force participation influences fertility in developed countries has long been an important issue. Examining the trend of female labor force participation and fertility in the U.S. over time, Weller (1977) concluded that the incompatibility of work and childrearing is responsible for the decline of fertility. This conclusion can hardly be challenged. Bernhardt (1993) also reasoned that not childbearing, but *childrearing* is responsible for the incompatibility. Several mechanisms have been identified as sources of incompatibility between these two variables, employment and fertility. First, if childrearing leads a woman to quit her job, the loss of foregone wages may prevent her from having children (Calhoun and Espenshade 1989). Second, women with jobs may lack time for childrearing (Willis 1973). And, finally, if a woman wants to pursue a career, childrearing might be a hindrance; so the pursuit of a career would decrease the probability of childbearing (Rindfuss and Brewster 1996).

Some scholars have also proffered other impacts of employment on fertility. Employment is posited to affect childrearing in at least two ways. First, it occasions time conflicts between the job and family responsibilities. Glass and Camarigg (1992) found that schedule flexibility and ease of job performance influence the compatibility of fertility and female participation in the labor force. Jobs with more than thirty working hours per week are unlikely to allow these two features of flexibility and ease of performance. Second, employment can influence the timing of childrearing, women's leaving, and re-entering the labor market (Presser 1989). Additionally, not only the demands of the job, but also different child parities may influence the compatibility of childrearing and paid work. Studies in Sweden have shown, for example, it is easier for working mothers to take care of their second and third child (Hoem and Hoem 1989).

At the micro level, there is no doubt that female employment negatively impacts fertility. At the macro level, however, the positive co-variance reported between female labor-force participation and fertility recently caused a worldwide stir. Rindfuss and Brewster (2000) showed that in 1970, among advanced industrialized countries, the correlation coefficient between female labor-force participation and fertility was -.571. Yet in 2000, the correlation was .718. In other words, in 2000, countries with higher female labor force participation rates had higher fertility rates.

The different trends between micro and macro data highlight that incompatibility between childrearing and paid work varies across countries and cultures. State policy has been identified as a key variable that curtails the negative influence of work on fertility. Chesnais (1996), for example, found that countries that treat childrearing as the state's responsibility, mainly the Nordic countries, have higher fertility. Pampel (1998) also argued that the "female-friendly" policies that allow women to work and rear a child at the same time are responsible for simultaneously higher female labor-force participation and fertility.

In less developed nations where female employment is viewed as a potentially important factor influencing fertility decline, the nexus between employment and fertility seems more varied. Dixon (1976), for instance, asserted that female employment may not affect reproductive behavior unless the employment is outside the traditional sector of unpaid family work or subsistence agricultural labor. In other words, so long as employment opportunities for women are largely restricted to unpaid family work or poorly paid jobs requiring limited skills, no effect on fertility is likely. In accord with that notion is the work of Jaffe and Zaumi (1960) in Japan and Puerto Rico, one of the earliest studies showing a similarity in fertility of women involved in home-centered employment and those not in the labor force. They pointed out that women employed in home industries had fertility no less than that of women not in the labor force; however, women working outside the home had lower fertility. Likewise, in Thailand, Goldstein (1972) found that only Bangkok has an inverse relationship between female employment and fertility. In rural, agricultural households, on the other hand, there was evidence of a small positive relationship.

Similar findings have been reported for various countries representing different cultural, developmental, and economic systems. A conditional employment-fertility relationship has been reported for areas as diverse as Thailand, the Philippines, and Malaysia (Concepcion 1974; Goldstein 1972; Mason and Palan 1981), Chile (Miro and Mertens 1968; Peek 1975), Puerto Rico (Weller 1968), Egypt (Bindary et al. 1973), and Italy (Pinelli 1971). Those studies tend to demonstrate the expected fertility difference between working and nonworking women in large urban areas, but a weak, or nonexistent, or even positive relationship among rural women. Aggregate level analyses, by contrast, tend consistently to reveal a negative impact of female employment on fertility. A strong inverse relationship between the rate of female employment outside the home and fertility is reported in Kasarda's (1971) analysis of approximately 50 nations and Heer and Thurner's (1965) analysis of Latin America.

Traditionally, economic development has been viewed as expanding women's participation into nontraditional productive spheres of society, which in turn would elevate their status. This belief was generally unquestioned until Boserup (1970) documented that the relationship between economic development and women's status may be an inverse one. Since then, many other empirical investigations have demonstrated the existence of a gap in gender status in the industrialization process of many developing societies, despite differences in those societies' particular schemes of development (Elliott 1977; Safa 1979). Likewise, even in contemporary Western industrialized societies such as the United States and Great Britain, where women have rapidly swelled the ranks of the labor force, the existence of sex segregation in the workplace is regarded as one of the most persistent social phenomena of the past few decades (Gross 1968; Williams 1979; Beller 1984; Roos 1985). In Rosabeth Moss Kanter's (1997) impressive and exemplary groundbreaking book, Men and Women of the Corporation, she describes the phenomena of limited opportunity structures and “tokenism,” which entail structural limitations on women in the workplace, according them little power and few opportunities for advancement.

As for empirical study of employment and fertility in China and Taiwan, Stokes and Hsieh (1983) conclude that in Taiwan female employment apparently has little impact on fertility preferences or behavior. Similarly, Cheng (1999), using multivariate time series analysis, finds that working women in Taiwan do not necessarily have fewer children. Also, comparing Hakka and Hokkien women in Taiwan, Wolf and Chuang (1994) conclude that although Hakka women (who did not practice foot-binding) go out to work, their fertility patterns are not different from those of Hokkiens, who practiced foot-binding and did not work outside the home. They further explain that Hakka women did not control the products of their labor, which may account for their failure to control their fertility. Peng (1989) asserts that female participation in the work force is very relevant to rural-urban differentials in fertility in China. on the other hand, Zhang (1990) using data from the 1985 China In-Depth Fertility Survey, reports that the relationship of the husband’s occupation to declining fertility rates is more significant than that of the wife's occupation.

In this dissertation, because of data availability, female employment status in Taiwan and China is operationalized as classification into either agricultural employment or non-agricultural. In addition, due to the sizeable number of women in Taiwan without an occupation, a "no-work status" variable for Taiwan is used in the analysis. In Chapter VI, the nexus between women's employment status and their fertility and sterilization behaviors will be explored at both an individual level and an aggregate level (by province or county). Also interaction between macro-level female employment structure and personal characteristics will be examined.

Familial Structure

In Western literature, educational level and employment status are regarded as the most important factors in the population fertility transition. In Taiwan, however, the family, to which the core of cultural values is attached, has long been the most important unit of social organization. Because Taiwan has been a society of immigrants from China since the seventeenth century, families in Taiwan have perpetuated the patrilineal and patrilocal characteristics of the Chinese society. In spite of social change on the heels of industrialization, urbanization and contact with Western ideas, the deep-seated values and behavioral patterns associated with Chinese family life have not been uprooted. Given this situation, it can be understood that childbearing decisions for women are made in an atmosphere of immense traditional social pressure. Ironically, through a process of revolutionary policies and the 1979 one-child policy (Peng 1991), China seems to have abandoned more traditional familial traits than Taiwan. The results of empirical studies, however, show that the traditional Chinese family values are still deeply imbedded in that socialist country.

According to the economic approach called the household-production model, family structure is positively related to fertility to the extent that the time of other family members can readily substitute for the wife's time. It is implied that a couple living in an extended family has lower-priced substitutes for the wife's time, because when the services of extended family members are used, they are likely to be paid for at a rate lower than the prevailing market wage, if paid for at all. Accordingly, the opportunity costs of children are lower for extended families than for nuclear families. However, Nag (1975) and Burch (1983) could not find empirical support for the idea that extended family/kinship relations are associated with higher fertility. At most, they concluded, extended family relationships only facilitate early marriage and reproduction and spread the costs and responsibilities of childbearing. Likewise, Vlassoff and Vlassoff (1983) found in the Maharashtra State that when age or stage of family life cycle was controlled, there was little connection between family type and fertility. Conversely, however, Jejeebhoy (1984) reported higher lifetime fertility among nuclear households in Maharashtra at all ages, even though recent fertility was only higher in nuclear families was among young women. Jejeebhoy thinks that instead of being a determinant of fertility, household type is more likely merely a function of past fertility and other life-cycle variables.

These findings differ from those of Freedman, Chang and Sun (1982) in Taiwan. Using residence histories to measure the length of time a couple has spent in a nuclear household, they found that couples who had always lived as a nuclear couple consistently ranked lowest in actual fertility, preferred fertility and underlying fertility preference; they also ranked high in percentage who used contraception to space childbirths. This was true both before and after adjustment for education and duration of marriage. As possible influences leading to higher fertility among couples living in extended households, the following factors are suggested: lower perceived costs of children, old age support, grandparents' pressure for children, and frequent expression of traditional filial sentiments. These suggestions are supported by other research as well (Weinstein et al. 1990; Yen et al. 1989). While also affirming the positive effects of patriarchal family structure on fertility in Taiwan, Hsiung (1988) reports that it is moderated by female educational level and occupational status. In China, Li (1995) finds that living with parents or parents-in-law also increases the probability of having another child, suggesting a persistent cultural preference among elderly people for a large family and its impact on their children's fertility behavior.

In this dissertation, to see whether there is an association between an extended-family residential arrangement and fertility behavior, I operationalize family influence by comparing respondents on basis of whether or not they live with their parents.

Sterilization

Shapiro (1985) uses the phrase "institutionalized discrimination" to describe how implementation of sterilization in the United States is systematically biased against the poor and women on welfare. Previous research has indicated that the form of sterilization used among couples is influenced in part by aspects of women's status. For instance, variability in male sterilization among couples in China is not only a function of socioeconomic and cultural factors, but also of women's status (Xu 1993). The economic and medical advantages of vasectomy are obvious, but the male sterilization rate is much lower than the female sterilization rate in most parts of this world. Aird (1990, pp. 25-26) documented that in China's second family planning campaign in the 1960s there was an effort to promote vasectomy but that it encountered strong resistance from the populace.

In China, under the one-child policy in the early 80s, sterilization emerged as the principle technical measure for birth control. Starting in 1982, in order to effectively control its burgeoning population in the vast rural areas, China adopted a birth control policy of "IUD insertion after the first birth and sterilization after the second birth" (SFPCC 2004).

Analyzing data from the One-Per-Thousand Fertility Survey of China, Poston (1986) found that the most popular contraceptive methods used by married fecund women of reproductive age (15-49) in 1982 were IUD (intrauterine device) and female sterilization. In Heilongjiang province, most women have used only one method: either the IUD or sterilization (Kaufman et. al. 1992). Couples with two or more children were designated as persons who should be sterilized. Official statistics revealed that sterilizations in China increased sharply in 1983 to nearly three times the number in the previous peak year, which was 1979 (Table 4.1). of the 20.8 million sterilizations in 1983, almost 80 percent were of females (Aird 1990).

Yet the male sterilization rate in China is not low. According to Ross (1992), China has over one-half of the total sterilization users in the world, and vasectomy reaches an appreciable level, where husbands of 10 percent of married women of reproductive age in 1985 were using this method. Based on a statistical survey conducted by the Health Ministry, about 30.4 million couples relied on vasectomy during 1971-1989, compared with 74.2 million women who accepted tubal ligation; the ratio of male to female sterilization during this period was, therefore, 0.41 to one. Conversely, Sun (2001) reports that in Taiwan, of the 8 million people who accepted government-provided contraceptive methods from 1964 to 1991, female sterilization was the method chosen by 9%, while male sterilization was just 0.6%. Lethbridge and Wang (1991) studied contraceptive usage in Taiwan with data collected from 159 married women of childbearing age in Taipei. None of the spouses of these women had undergone a vasectomy.

In China, parity status and age are the main determinants of the choice to accept sterilization. In China’s 1984 one-per-thousand fertility sample survey, ethnic minorities used it less than the Han. The effect of education on contraceptive usage in China has also has been acknowledged. Li and Lin (2000) studied on Chinese contraceptive choice in 1998, they reported that the percentage of sterilization in illiterate females was 50.6%; for women with elementary school, it was 43.5%; for women with junior-high schooling, 36.1%; and for women with high-school education and above, 25.7%. Zhong (2000) found that women with low education generally have little knowledge of contraceptive methods.

Zhou's study of Chinese women's contraceptive patterns found that the general contraceptive rate of urban women was higher than that of rural women. For urban women, sterilization was the second most widely chosen contraceptive method, but it was the first choice among rural women (Zhou 1991).

Short and colleagues. (2000) discovered the following association in China between sterilization usage and local birth planning policies: the risk of sterilization is highest in communities where the birth planning policy is least robust. “When other methods (including perhaps abortion) can be used more effectively, birth planning cadres may be less likely to promote sterilization" (Short et al. 2000, p.280).

In this dissertation, I identify sterilization as a dependent variable to see whether individual-level women's status influences sterilization behaviors. In addition, in the multilevel analysis, the degree to which aggregate-level women's status mediates the influence of personal characteristics on sterilization behavior will be a main concern. It is expected that, the personal characteristics of Taiwanese women may play a salient role in the decision to choose sterilization. In China, due to the enforced-policy orientation there, it is expected that the macro-level effectiveness of family program promotion will be a decisive factor.

Table 4.1 Birth Control Surgeries in China: 1971-1986.

Year	IUD Insertions	Vasectomies	Tubal Ligations	Abortions
1971	6172889	1223480	1744644	3910110
1972	9220297	1715822	2087160	4813452
1973	13949569	1933210	2955617	5110405
1974	12579886	1445251	2275741	4984564
1975	16743693	2652653	3280042	5084260
1976	11626510	1495540	2707849	4742946
1977	12974313	2616876	2776448	5229569
1978	10962517	767542	2511413	5391204
1979	13472392	1673947	5289518	7856587
1980	11491871	1363508	3842006	9527644
1981	10344537	649476	1555971	8696943
1982	14069161	1230967	3925927	12419663
1983	17755736	4359261	16398378	14371843
1984	11751146	1293286	5417163	8890140
1985	9576980	575564	2283971	10931565
1971-85	182691497	24996383	59051848	111960895

Source: Aird 1990. p. 40

CHAPTER V

DATA, VARIABLES AND METHODOLOGY

Data

The individual-level data for China to be used in this dissertation are from the 1988 Two-per-Thousand Fertility Survey in which the State Family Planning Commission in China surveyed 2,151,212 women from 30 provinces and other regions in July 1988,. I restricted the total sample to married women whose husbands live in the same household. From this revised sample, I took a 10% sample. After dropping women older than 58 years, duplicates and some bad data entries, I obtained 30,013 observations (Table 5.1). The provincial data are adopted from the 1990 Census of China. The 1990 China Census data are accessible and are chronologically close to 1988. I correlated some developmental indicators based on data from the 1982 China Census with those from the 1990 China Census and found that the pairs are highly correlated. For example, the correlation coefficient of Population in Agriculture to Total Employed Population (agr) between 1982 and 1990 is .94 (Table 5.2). So I feel it is safe to use the 1990 China Census data as macro-level resources. Since data for Tibet are lacking, I have data for only 29 provinces (Table 5.3).

The data for Taiwan to be used in my dissertation include 11,690 respondents from a sample drawn from the 1992 “Knowledge, Attitude, and Practice” (KAP) survey of family planning among married women. It is an island-wide survey based on probability samples representing married women of childbearing age from 20 to 45.

Table 5.1 Descriptive Statistics of Individual and Provincial Variables in China.

Individual Variable	Obs	Mean	Std. Dev.	Minimum	Maximum
Children Ever Born	30,013	2.714	1.979	0	15
Sterilization Status	30,013	0.340	0.474	0	1
Male Sterilization Status	30,013	0.065	0.246	0	1
Female Sterilization Status	30,013	0.277	0.447	0	1
The Duration between marital month to first pregnancy ending month	30,013	28.756	97.438	0	524
The Duration between first pregnancy ending month to second pregnancy ending month	23,707	29.001	17.467	0	240
The Duration between second pregnancy ending month to third pregnancy ending month	16,759	31.087	19.479	0	240
Wife's Education	30,013	1.610	1.439	0	14
Husband's Education	30,013	2.380	1.277	0	14
Marital Period in Month	30,013	180.293	130.081	6	574
Married More than 14 years	30,013	0.451	0.498	0	1
Wife's Age	30,013	35.880	9.856	16	58
Husband's Age	30,013	38.643	10.997	16	86
Han Status	30,013	0.897	0.303	0	1
Three-Generation Familial Structure	30,013	0.079	0.269	0	1
Wife's Agricultural Occupation	30,013	0.752	0.432	0	1
Husband's Agricultural Occupation	30,013	0.668	0.471	0	1
Number of Dead Children	30,013	0.246	0.666	0	9
Number of Boys	30,013	1.402	1.245	0	12
Number of Girls	30,013	1.314	1.309	0	14
No One-child Certificate	30,013	0.840	0.366	0	1
Experience of Childbirth with Quota	30,013	0.340	0.474	0	1
Living in Rural Area	30,013	0.815	0.388	0	1
Provincial Variable					
Total Fertility Rate	30,013	2342.1	728.5	1304.8	4609.3
o-year-old Mortality Rate	30,013	0.026	0.015	0.006	0.068
Female Occupation Participation Rate	30,013	0.711	0.079	0.536	0.812
Female Divorce Rate	30,013	0.004	0.003	0.002	0.027
Female College Gradation Rate	30,013	0.005	0.008	0.001	0.046
Agricultural Participation Rate	30,013	0.517	0.157	0.085	0.704
One-Child Certificate Rate	30,013	0.068	0.050	0.021	0.257

Source: SFPCC 1989, and NBSC 1991

Table 5.2 Correlation Matrix of 1982 and 1990 Census Variables in China.

	birthr	imr82	colr	agr82	indr	empr	fopr	imr	tfr	fdr	agr	fcr	papr
birthr	1.00												
imr82	0.72	1.00											
colr	-0.24	-0.28	1.00										
agr82	0.44	0.44	-0.77	1.00									
indr	-0.52	-0.52	0.77	-0.98	1.00								
empr	-0.34	-0.31	0.37	-0.12	0.28	1.00							
fopr	0.21	0.30	-0.32	0.65	-0.55	0.43	1.00						
imr	0.72	0.89	-0.39	0.55	-0.60	-0.35	0.42	1.00					
tfr	0.31	0.27	-0.43	0.54	-0.51	0.00	0.50	0.30	1.00				
fdr	0.48	0.55	0.19	-0.18	0.10	-0.19	-0.18	0.41	0.01	1.00			
agr	0.28	0.37	-0.81	0.94	-0.92	-0.18	0.69	0.52	0.54	-0.28	1.00		
fcr	-0.18	-0.26	0.94	-0.66	0.67	0.36	-0.32	-0.36	-0.48	0.21	-0.76	1.00	
papr	-0.40	-0.39	0.79	-0.85	0.87	0.45	-0.36	-0.49	-0.53	0.20	-0.84	0.72	1.00

Source: NBSC 1991and NBSC 1983

Note:

birthr: Birth Rate (unit: 0.1%), 1982

imr82: Infant Mortality Rate (unit: 0.1%), 1982

colr: Number of College Graduates Per 10,000 Population (unit: 0.1%), 1982

agr82: Population in Agriculture to Total Employed Population (unit: %), 1982

indr: Industrial Population to Total Employed Population. (unit: %), 1982

empr: Employed Population to Total Population. (unit: %), 1982

tfr: Total Fertility Rate, 1989

imr: Infant Mortality Rate, 1989

fopr: Female Occupation Participation Rate, 1990

fdr: Female Divorce Rate, 1990

fcr: Female College Gradation Rate, 1990

agr: Population in Agriculture to Total Employed Population (unit: %), 1990

Table 5.3 Average Children Ever Born, Three Sterilization Status and Seven Macro-level Variables of 29 Provinces in China, 1990

Province	Children Ever Born	Sterilization Rate	Male Sterilization Rate	Female Sterilization Rate	Female Occupation Particip. Rate	o-year-old Mortality Rate	Total Fertility Rate	Female Divorce Rate	Agricultural Participation Rate	Female College Gradation Rate	One-Child Paper Rate
Beijing	2.517	0.163	0.004	0.159	0.638	0.009	1304.820	0.007	0.130	0.072	0.163
Tianjin	2.745	0.225	0.014	0.210	0.644	0.006	1658.610	0.005	0.210	0.035	0.185
Hebei	3.282	0.428	0.049	0.379	0.701	0.010	2351.070	0.002	0.607	0.006	0.049
Shanxi	3.815	0.349	0.006	0.344	0.587	0.019	2415.420	0.003	0.466	0.008	0.035
Neimenggu	3.818	0.440	0.007	0.433	0.619	0.029	1969.490	0.003	0.465	0.012	0.057
Liaoning	2.972	0.363	0.003	0.360	0.645	0.019	1499.930	0.006	0.356	0.019	0.131
Jilin	2.998	0.402	0.003	0.399	0.586	0.025	1784.170	0.006	0.405	0.016	0.100
Heilongjiang	3.176	0.386	0.001	0.385	0.536	0.019	1698.050	0.006	0.350	0.019	0.098
Shanghai	2.088	0.266	0.064	0.202	0.687	0.013	1333.580	0.009	0.085	0.039	0.257
Jiangsu	2.953	0.160	0.021	0.139	0.782	0.015	4609.270	0.002	0.476	0.012	0.086
Zhejiang	3.167	0.512	0.029	0.482	0.659	0.018	1398.560	0.002	0.409	0.006	0.054
Anhui	3.947	0.079	0.013	0.065	0.787	0.025	2497.460	0.002	0.661	0.005	0.034
Fujian	3.768	0.562	0.130	0.441	0.600	0.024	2376.970	0.002	0.476	0.008	0.037
Jiangxi	4.288	0.553	0.012	0.540	0.737	0.043	2467.020	0.002	0.588	0.005	0.027
Shandong	2.547	0.454	0.184	0.273	0.772	0.014	2467.180	0.002	0.632	0.004	0.058
Henan	3.773	0.186	0.046	0.142	0.782	0.019	2902.260	0.002	0.682	0.006	0.030
Hubei	3.688	0.424	0.060	0.365	0.772	0.026	2510.590	0.003	0.580	0.012	0.065
Hunan	3.878	0.548	0.155	0.394	0.742	0.039	2381.210	0.003	0.626	0.005	0.036
Guangdong	3.724	0.595	0.145	0.454	0.703	0.016	2489.930	0.002	0.460	0.006	0.035
Guangxi	4.430	0.119	0.034	0.086	0.787	0.047	2741.480	0.003	0.676	0.004	0.021
Hainan	4.440	0.371	0.041	0.330	0.724	0.029	2846.330	0.003	0.540	0.007	0.024
Sichuan	3.539	0.578	0.444	0.144	0.806	0.039	1761.880	0.004	0.682	0.009	0.093
Guizhou	4.852	0.422	0.198	0.227	0.808	0.054	2977.570	0.003	0.704	0.009	0.028
Yunnan	4.632	0.198	0.071	0.127	0.812	0.068	2571.360	0.005	0.696	0.010	0.028
Shaanxi	3.692	0.284	0.026	0.258	0.699	0.023	2688.180	0.003	0.584	0.011	0.049
Gansu	4.154	0.550	0.005	0.545	0.783	0.033	2320.840	0.003	0.655	0.010	0.038
Qinghai	4.503	0.256	0.005	0.251	0.729	0.068	2419.990	0.012	0.531	0.011	0.038
Ningxia	3.645	0.288	0.000	0.288	0.745	0.038	2612.390	0.004	0.555	0.007	0.026
Xinjiang	3.408	0.412	0.032	0.379	0.680	0.060	3188.950	0.027	0.479	0.009	0.050

Source: SFPCC 1989, and NBSC 1991

Table 5.4 Descriptive Statistics of Individual and County Variables in Taiwan.

Individual Variable	Obs	Mean	Std. Dev.	Minimum	Maximum
Children Ever Born	11,502	2.479	1.185	0	9
Sterilization Status	11,502	0.285	0.451	0	1
Male Sterilization Status	11,502	0.014	0.119	0	1
Female Sterilization Status	11,502	0.270	0.444	0	1
The Duration between marital month to first pregnancy ending month	10,971	18.125	17.490	0	220
The Duration between first pregnancy ending month to second pregnancy ending month	9,656	24.039	16.384	0	169
The Duration between second pregnancy ending month to third pregnancy ending month	6,151	28.797	21.182	0	505
Wife's Education	11,502	9.062	3.674	0	17
Husband's Education	11,499	10.126	3.575	0	17
Marital Period in Month	11,499	138.703	79.777	1	376
Wife's Age	11,499	34.083	5.867	21	45
No work Status	11,502	0.289	0.453	0	1
Mainlander Status	11,502	0.142	0.350	0	1
Whether owning Piano	11,502	0.127	0.333	0	1
Three-Generation Familial Structure	11,502	0.353	0.478	0	1
Wife's Agricultural Occupation	11,502	0.033	0.179	0	1
Husband's Agricultural Occupation	11,502	0.067	0.251	0	1
Number of Dead Children	11,253	0.044	0.242	0	6
Number of Boys	11,499	1.273	0.911	0	6
Number of Girls	11,499	1.205	1.064	0	9
County Variable					
Total Fertility Rate	11,502	1752.315	203.115	1365	2135
o-year-old Mortality Rate	11,502	0.026	0.016	0.014	0.069
Female Occupation Participation Rate	11,502	0.526	0.083	0.367	0.660
Female Divorce Rate	11,502	0.006	0.002	0.0026	0.009
Female College Gradation Rate	11,502	0.052	0.030	0.028	0.167
Agricultural Participation Rate	11,502	22.652	16.230	1.2	57.8

Source: TAPIFP 1992, and EYRC 1992

Table 5.5 Average Children Ever Born, Three Sterilization Status and Six Macro-Level Variables of 23 Counties in Taiwan, 1992

COUNTY	Children Ever Born	Sterilization Rate	Male Sterilization Rate	Female Sterilization Rate	Female Occupation Participation Rate	o-year-old Mortality Rate	Total Fertility Rate	Female Divorce Rate	Agricultural Participation Rate	Female College Gradation Rate
Taipei City	1.996	0.183	0.020	0.163	0.660	17.120	1365.000	8.100	1.200	0.167
Keelong City	2.250	0.264	0.023	0.241	0.389	15.450	1590.000	8.700	3.800	0.045
Taichung City	2.229	0.232	0.008	0.224	0.425	23.420	1660.000	7.400	10.600	0.098
Tainan City	2.358	0.306	0.017	0.288	0.466	14.490	1485.000	6.800	12.600	0.066
Koushiang City	2.226	0.275	0.008	0.266	0.500	16.740	1475.000	8.200	6.900	0.060
Shinchu City	2.383	0.205	0.023	0.182	0.582	14.770	1785.000	6.500	10.900	0.065
Chayee City	2.375	0.290	0.013	0.277	0.392	14.120	1510.000	5.800	10.500	0.072
Ilan County	2.650	0.280	0.022	0.258	0.417	21.840	1880.000	5.700	22.800	0.056
Taipei County	2.381	0.227	0.015	0.213	0.581	14.920	1695.000	7.600	3.800	0.039
Taoyuan County	2.443	0.282	0.025	0.257	0.611	25.770	1840.000	7.100	16.800	0.040
Shinchu County	2.599	0.259	0.022	0.235	0.630	53.450	2135.000	5.200	25.400	0.035
Maoli County	2.628	0.267	0.010	0.251	0.594	29.520	2030.000	4.900	26.600	0.042
Taichung County	2.535	0.313	0.016	0.297	0.496	24.470	1875.000	5.200	25.200	0.034
Changhua County	2.748	0.416	0.015	0.401	0.452	13.940	1945.000	3.400	33.500	0.034
Nantou County	2.624	0.340	0.008	0.332	0.623	26.820	1965.000	5.300	41.200	0.036
Yulin County	2.709	0.370	0.011	0.359	0.559	40.180	1920.000	3.400	57.800	0.052
Chayee County	2.842	0.381	0.017	0.364	0.540	29.450	1940.000	2.600	55.000	0.038
Tainan County	2.565	0.425	0.021	0.404	0.505	21.760	1730.000	4.500	38.500	0.033
Koushiang County	2.485	0.228	0.009	0.219	0.493	19.080	1735.000	6.100	26.400	0.059
Pinton County	2.559	0.286	0.005	0.282	0.543	18.700	1775.000	6.200	43.400	0.032
Taidon County	2.855	0.328	0.000	0.328	0.571	69.430	1995.000	9.000	40.700	0.038
Hualain County	2.580	0.282	0.012	0.270	0.367	61.170	1875.000	9.700	28.000	0.032
Penghu County	2.822	0.290	0.000	0.290	0.470	62.960	1700.000	5.000	37.600	0.028

Source: TAPIFP 1992, and EYRC 1992

After deleting cases with missing values on demographic variables, 11,502 women remain (Table 5.4). The county data are from the Taiwan-Fukien Demographic Fact Book 1992. I have data on 23 counties or cities (Table 5.5). In both China and Taiwan the dependent variable of children ever born is measured by the number of all live-born children the respondent reported. The dependent variable of sterilization status is represented by a dummy variable; 1 is coded when either member of the married couple has undergone sterilization, and 0 is coded for no sterilization. The dependent variables of male sterilization status and female sterilization status are measured in a similar way. Three aspects of dependent variables are computed in months: the duration from marriage to first pregnancy, duration from first pregnancy to second pregnancy, and duration from second pregnancy to third pregnancy, regardless of whether the outcome of the pregnancy was live childbirth, stillbirth, or miscarriage.

The independent variables pertain both to individuals (level-1) and to their aggregate units (level-2, province or county). For both Taiwan and China, there are ten common micro-level variables and five common macro-level variables. For China, to measure the effect of the one-child policy on fertility behavior, I also include both a macro-level and a micro-level variable of whether respondents received a one-child certificate. For China I also include a micro-level variable of whether the respondent reports accepting a locally prescribed birth quota. Feeney and Wang (1993) described the difficulty of classifying people into three living residence categories--village, town and city--for the 1988 Two-per-Thousand Fertility Survey. Because, however, abundant research literature supports an obvious difference in fertility behavior between rural and city dwellers in China, I constructed an index of rural status by calculating the percentage of persons designated as farmers for each of 3,184 sample units of the 1988 survey. Observations in the sample unit with percentages over 50 were classified as living in rural areas. In addition, because the fertility policy in China has been more strictly enforced since the 1970s, I attempt to control this effect by constructing an index of age groups based on whether couples had been married longer than 14 years in 1988. Presumably, a couple who married in 1974 or later would have fewer fertility behaviors because of the implementation of "Wan-Xi-Shao" ("Later-Longer-Fewer") policy in 1973 and the one-child policy in 1979 (Xie 2000).

With the Taiwanese data, I examined the effect of different living standards or wealth levels. Pianos in Taiwan are imported and expensive, so they symbolize the luxury of leisured classes. Also, Freedman (1972) found that couples successfully planning their family size also manage their economic affairs so that they can save and enjoy more modern consumer goods. Therefore, I include, as an indicator of wealth, a variable of whether the household owns a piano.

With the level-1 variables, I will mainly examine the effects of women's status on fertility behavior. One of the most important women's status variables is educational attainment. In Taiwan, this variable is measured as the number of school years completed from 0 to 17. In the China data, however, there are only five categories, from 0 (standing for illiterate) to 5 (standing for college graduation); for the purpose of converting it to an interval variable, I recoded the illiterate category as 0 schooling years, the just literate category as 2 schooling years, the primary school category as 6 schooling years, the junior high school category as 9 schooling years, the senior high school category as 11 schooling years, and the college category as 14 school years. In Taiwan, women's average schooling years are 9.1, compared with 10.1 for their husbands (Table 5.4). In China, women's average number of school years is 6.2, compared with 8.5 for their husbands (Table 5.1).

Labor force experience is measured as a dummy variable, whether the wife and husband's occupations were agricultural. In China, 75.2% of wives and 66.8% of husbands are working in agricultural fields, compared with 3.3% of wives and 6.7% of husbands in Taiwan. In addition, with the Taiwanese data, I recoded an extra variable--no work status for wives if they never worked outside the home. Slightly more than a fourth, 28.9%, of women have never worked outside the home. This variable may give us a clear picture of the effect of work experience on the issues in question.

To examine the effects of familial structure on women's fertility behavior, in Taiwan if respondents answered they currently live with parents, and in China if respondents and parents lived together in the household unit, then the dummy variable of three-generation familial structure is coded as 1. In China, only 7.8% of respondents live with their parents, compared with 35.3% in Taiwan.

Marital period in months may stand for the measure of age at marriage and marital experience. In China, the wife's average marital period is 180.3 months, compared with 138.7 months for their Taiwanese counterparts. In this dissertation, women's average age in China is 35.9 years and in Taiwan, 34.1. In China, the minority nationalities (non-Han) are noted for higher fertility, partly due to policy laxity. Previous studies also show that those who have immigrated to Taiwan since 1949, also known as "mainlanders," have lower fertility rates. Therefore, if wives or husbands are Han or mainlanders, then the dummy variables are recoded as 1. Almost 90% of respondents in China are Han, and 14.2% of respondents in Taiwan are mainlanders. The "number of dead children" is defined as a live birth but dead within one year. Chinese women have an average of 0.25, larger than the 0.04 for Taiwanese. Chinese women have 1.4 boys, while Taiwanese have 1.3.

In China, 82% of the women in the 1988 survey live in a rural area as already operationally defined. Forty-five percent of the women have been married for more than 14 years. Those who accept the one-child certificate will get better benefits but will be punished if they violate the agreement. In our sample, 16% of respondents claim that they accepted this certificate. Thirty-four percent of women have experience in accepting the locally prescribed birth quota. As mentioned above, in Taiwan, whether the household owns a piano indicates higher living standards; almost 13% of respondents in the 1992 KAP have a piano at home.

I use six common my level-2 independent variables, and one more variable for China.

The first aggregate variable is the total fertility rate (TFR). In China, the 1989 TFR is 2370; the 1991 TFR for Taiwan is 1752.

The second aggregate variable is the rate of occurrence of child death before one year of age, called 0-year-old-age mortality rate (0MR) as a proxy for the infant mortality rate. In China, the 1989 0MR is 2.8%; the 1991 Taiwanese 0MR is 2.6%.

The third aggregate variable is the female occupation participation rate, which is measured as the proportion of total female workers to the total number of women older than 15 years. In China, the 1989 female occupation participation rate is 71.6%; the Taiwanese rate is 52.6%.

The fourth aggregate variable is the female divorce rate, which is measured as the proportion of total divorced females to the total number of women older than 15 years. In China, the 1989 female divorce rate is 0.04%; the Taiwanese rate is 0.06%.

The fifth aggregate variable is the female college graduation rate, which is measured as the proportion of females 25 years old and above with at least a college degree to all women 25 years and older. I use data from the 1988 fertility survey for China and the 1992 KAP Survey for Taiwan. In China, the female college graduation rate is 1.3%; the Taiwanese rate is 5.2%.

The sixth aggregate variable is the agricultural participation rate, which is measured as the proportion of agricultural workers to the total population older than 15 years. In China, the 1989 agricultural participation rate is 52.7%; the Taiwanese rate is 22.7%.

Freedman and his associates (1988) consider the one-child ratio as a plausible proxy for program effect. Accordingly, I examine the prevalence of one-child certificates at the provincial level, calculated from the 1988 fertility survey. The average rate is 6.5%. According to Table 5.3, Shanghai, Tianjin and Beijing are the three provinces with the greatest prevalence of certificates.

Hypotheses

In this research, I propose to test 7 macro-level and 14 micro-level hypotheses based on the literature and theoretical review in Chapter IV. In terms of the cross-level effects for multi-level analysis, I expect that macro-level (level-2) variables generally affect the slope of the micro-level (level-1) variables on the outcome variables, so that the final result of fertility behavior will be consistent with the relationship presented by the macro-level hypotheses.

The macro-level hypotheses are the following:

(1) The higher the total fertility rate in the province or county, the greater the number of children a woman will have ever born, and the lower her or her husband's probability of being sterilized.

(2) The higher the 0-year-old-age mortality rate in the province or county, the greater the number of children a woman will have ever born, and the lower her or her husband's probability of being sterilized.

(3) The lower the female occupation participation rate in the province or county, the greater the number of children a woman will have ever born, and the higher her probability of being sterilized.

(4) The lower the female divorce rate in the province or county, the greater the number of children a woman will have ever born, and the higher her probability of being sterilized.

(5) The lower the female college graduation rate in the province or county, the greater the number of children a woman will have ever born, and the higher her probability of being sterilized.

(6) The higher the agricultural participation rate in the province or county, the greater the number of children a woman will have ever born, and the lower her or her husband's probability of being sterilized.

(7) The lower the one-child certificate rate in the Chinese province, the greater the number of children a woman will have ever born, and the lower her or her husband's probability of being sterilized.

The micro-level hypotheses are the following:

(1) The lower the wife's education, the greater the number of children she will have ever born, the greater her probability of being sterilized, the less her husband's probability of being sterilized, and the greater the hazard of going from the marriage or birth event to the next birth.

(2) The lower the husband's education, the greater the number of children his wife will have ever born, the greater his and his wife's probability of being sterilized, and the greater the hazard of going from the marriage or birth event to the next birth.

(3) The longer the wife's marital period, that is, the younger the marital age, the greater the number of children she will have ever born, the greater her and her husband's probability of being sterilized, and the greater the hazard of going from the marriage or birth event to the next birth.

(4) Those who are Han in China or mainlanders in Taiwan should have fewer children ever born, a greater probability of being sterilized, and a lower hazard of going from the marriage or birth event to the next birth than those not having this race status.

(5) Those who live with parents should have more children ever born, a lower probability of being sterilized, and a greater hazard of going from the marriage or birth event to the next birth than those not living with parents.

(6) The greater the number of dead children, the greater the number of children a woman will have ever born, the lower her and her husband's probability of being sterilized, and the greater the hazard of going from one birth event to the next.

(7) The greater the number of male births, the greater the probability of being sterilized, and the less the hazard of going from one birth event to the next.

(8) Wives who are in agricultural occupations should have more children ever born, a lower probability of being sterilized, and a greater hazard of going from the marriage or birth event to the next birth, than those who are not.

(9) Wives with husbands who are in agricultural occupations should have more children ever born, a lower probability of being sterilized, and a greater hazard of going from the marriage or birth event to the next birth, than those who do not.

(10) Wives in Taiwan who have never worked outside the home should have a greater number of children ever born, a greater probability of being sterilized, and a greater hazard of going from the marriage or birth event to the next birth, than those who work outside the home.

(11) Those in Taiwan who have a piano at home should have fewer children ever born, a lower probability of being sterilized, and a lower hazard of going from the marriage or birth event to the next birth, than those who do not have one.

(12) Those in China who do not accept the one-child certificate should have more children ever born, a lower probability of being sterilized, and a greater hazard of going from marriage or birth event to the next birth, than those who do not accept one.

(13) Those in China who have experience accepting the birth quota should have less children ever born, a higher probability of being sterilized, and a less hazard of going from marriage or birth event to the next birth, than those who do not have one.

(14) Those in China who live in rural areas should have more children ever born, a higher probability of being sterilized, and a greater hazard of going from marriage or birth event to the next birth, than those who do not have one.

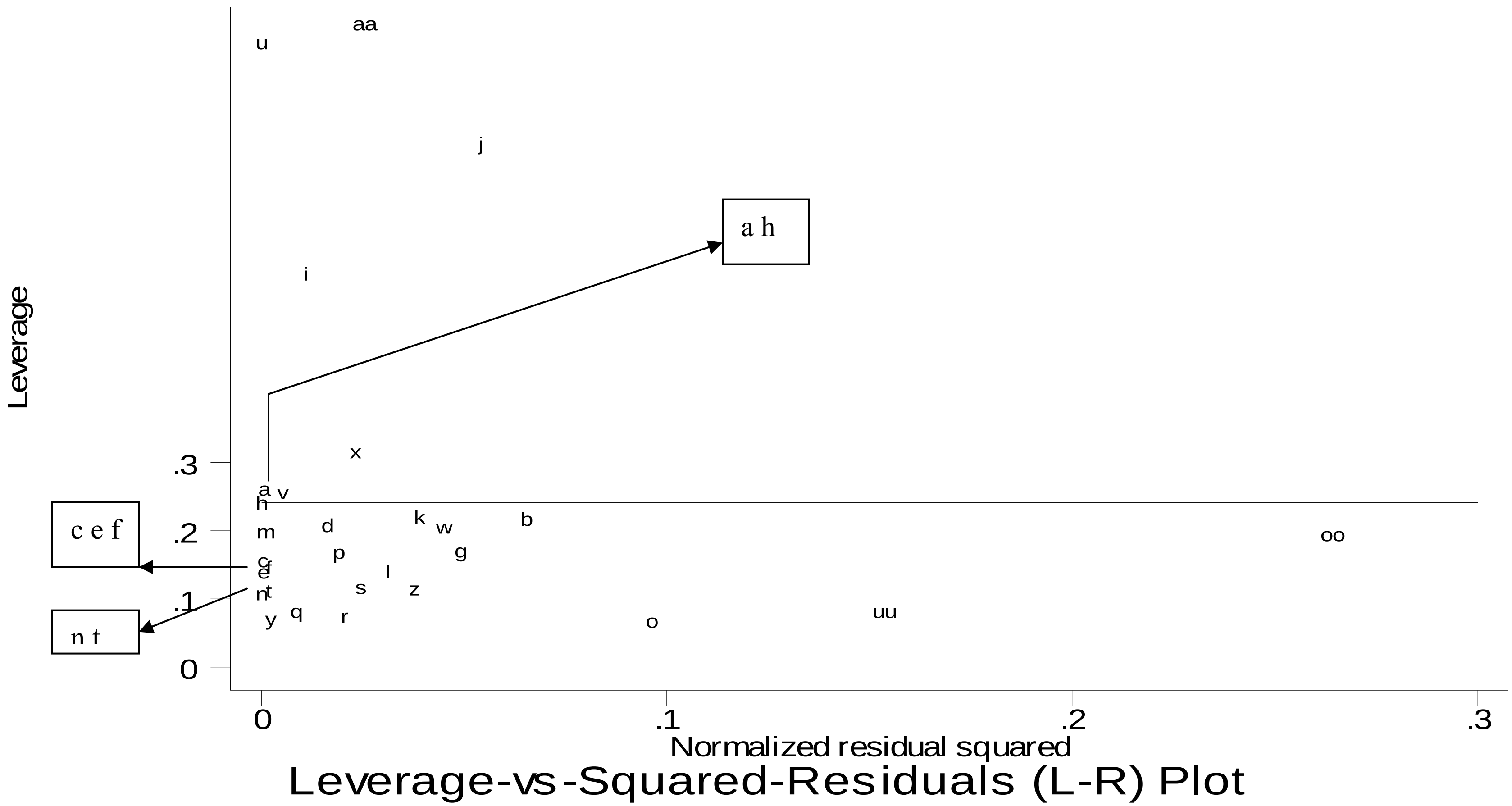
Methods

Six methods of analysis are applied to the data in this study. A Robust Regression Model is used to examine effects of the independent variables at the macro level. Poisson, logistic and survival analyses are individual-level methods. Bernoulli and Poisson models of Hierarchical Generalized Linear Modeling (HGLM) are methods of multilevel analysis.

Robust Regression Model

To determine the relationship between the predictors and dependent variables at the macro level, I regress the number of CEB (children ever born) and the sterilization rate at the provincial and county levels on aggregate level predictors acquired from Table 5.3 for China and Table 5.5 for Taiwan. Although OLS is an efficient estimator given normally distributed errors, it loses efficiency when error distributions have heavier than normal tails. When the distribution of the residuals includes outliers, and/or is abnormal with heavy tails, robust techniques yield estimates which are more efficient than OLS estimates (Hamilton 1992).

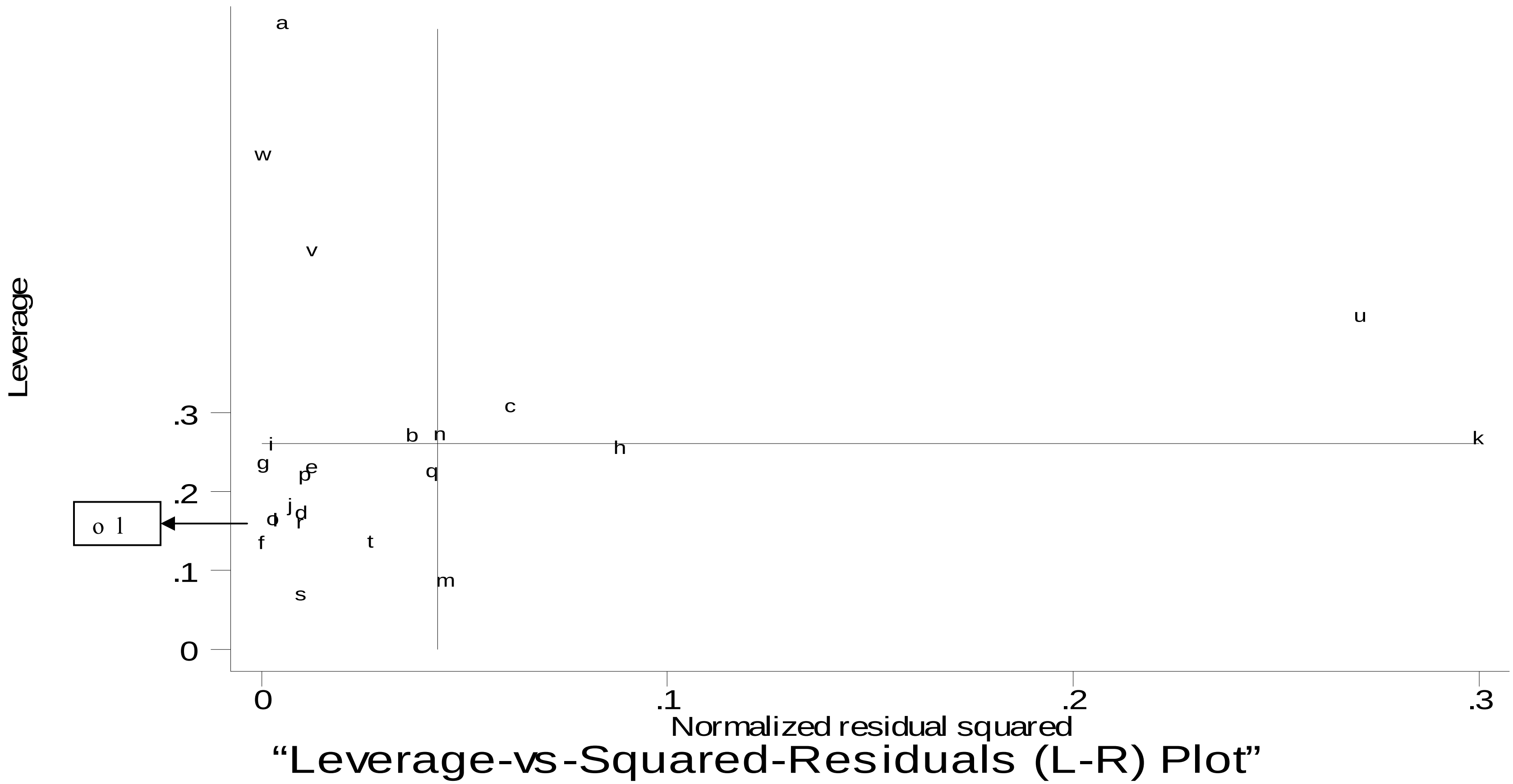
On the L-R chart (please refer to Figure 5.1 and Figure 5.2), the horizontal and vertical lines mark the mean of leverage (horizontal line) and the mean of squared residuals (vertical line). Leverage Scores indicate each observation's (i.e., province's) potential to influence the regression model due to its unusual combination of values on one or more X variables. Large values on the squared residuals indicate observations with Y values, in this case CEB, which are very much different from those predicted by the OLS regression model.



Source: SFPCC 1989

Note: aa: Beijing a: Qinghai b: Tianjin c: Hebei d: Shanxi e: Neimenggu f: Liaoning g: Jilin h: Heilongjiang i: Shanghai j: Jiangsu k: Zhejiang l: Anhui m: Fujian n: Jiangxi o: Ningxia oo: Shandong p: Henan q: Hubei r: Hunan s: Guangdong t: Guangxi uu: Hainan u: Xinjiang v: Sichuan w: Guizhou x: Yunnan y: Shaanxi z: Gansu

Figure 5.1 Leverage-vs-Squared-Residuals Plot for CEB OLS Models of Provinces in China



Source: TAPIFP 1992

Note: a: Taipei City b: Keelong City c: Taichung City d: Tainan City e: Koushiang City f: Shinchu City g: Chayee City h: Ilan County i: Taipei County j: Taoyuan County k: Shinchu County l: Maoli County m: Taichung County n: Changhua County o: Nantou County p: Yulin County q: Chayee County r: Tainan County s: Koushiang County t: Pinton County u: Taidon County v: Hualain County w: Penghu County

Figure 5.2 Leverage-vs-Squared-Residuals Plot for CEB OLS Models of Cities/Counties in Taiwan

Table 5.6 Leverages of Provinces/Counties Bigger Than 0.2 for CEB OLS Models of China and Taiwan.

China		Taiwan	
Province	Leverage	County	Leverage
Beijing	0.934	Keelong City	0.263
Tianjin	0.207	Taichung City	0.300
Heilongjiang	0.232	Koushiang City	0.224
Shanghai	0.567	Chayee City	0.229
Jiangsu	0.757	Ilan County	0.248
Zhejiang	0.211	Taipei County	0.252
Sichuan	0.247	Shinchu County	0.260
Yunnan	0.307	Changhua County	0.265
Qinghai	0.252	Yulin County	0.214
Xinjiang	0.907	Chayee County	0.219
		Taidon County	0.415
		Hualain County	0.499
		Penghu County	0.621

Source: SFPCC 1989, and TAPIFP 1992

Hence, Jiangsu is an obvious outlier in China; Taidon and Taichung for Taiwan. Plus, referred with the Table 5.6, we can see the leverages of Beijing, Shanghai, Jiangsu, Xinjiang in China, and Penghu County in Taiwan are over 0.5, the so-called “avoid if possible” rule of thumb value. Besides, according to the caution of Hamilton (1992), there are four OLS coefficients are more than one robust standard error from the corresponding robust coefficient in China and one in Taiwan (please, refer to Table 5.7) . These diagnosis results suggest the legitimacy of using robust regression rather than OLS for province/county level analysis.

Table 5.7 Comparisons of Results of CEB OLS and Robust Models of China and Taiwan.

	China					Taiwan				
	OLS Estimates		Robust Estimates			OLS Estimates		Robust Estimates		
CEB	Coef.	Std. Err.	Coef.	Std. Err.	Compare/ by robust standard error	Coef.	Std. Err.	Coef.	Std. Err.	Compare/by robust standard error
fopr	-0.769	1.017	0.453	0.798	-1.531	-0.239	0.255	-0.264	0.218	0.112
imr	29.020	5.546	20.848	4.118	1.984	0.006	0.001	0.005	0.001	0.875
tfr	0.000	0.000	0.000	0.000	-0.977	0.000	0.000	0.000	0.000	0.204
fdr	-54.597	16.907	-49.582	12.869	-0.390	-0.051	0.012	-0.063	0.010	1.156
fcr	6.742	6.536	41.335	15.683	-2.206	-2.244	0.887	-2.221	0.759	-0.030
papr	-5.734	1.999	-10.274	3.395	1.338					
_cons	3.732	0.605	2.701	0.390	2.646	2.516	0.310	2.674	0.265	-0.597

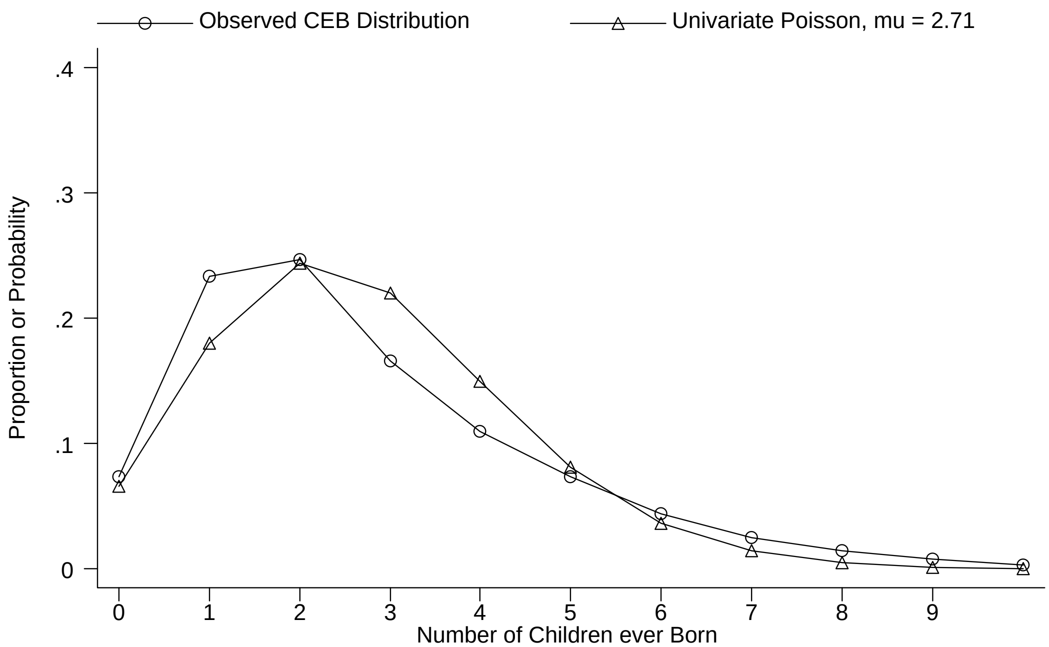
tfr: Total Fertility Rate fdr: Female Divorce Rate
imr: Infant Mortality Rate fcr: Female College Gradation Rate
fopr: Female Occupation Participation Rate papr: One-Child Certificate Rate

Source: SFPCC 1989, and TAPIFP 1992

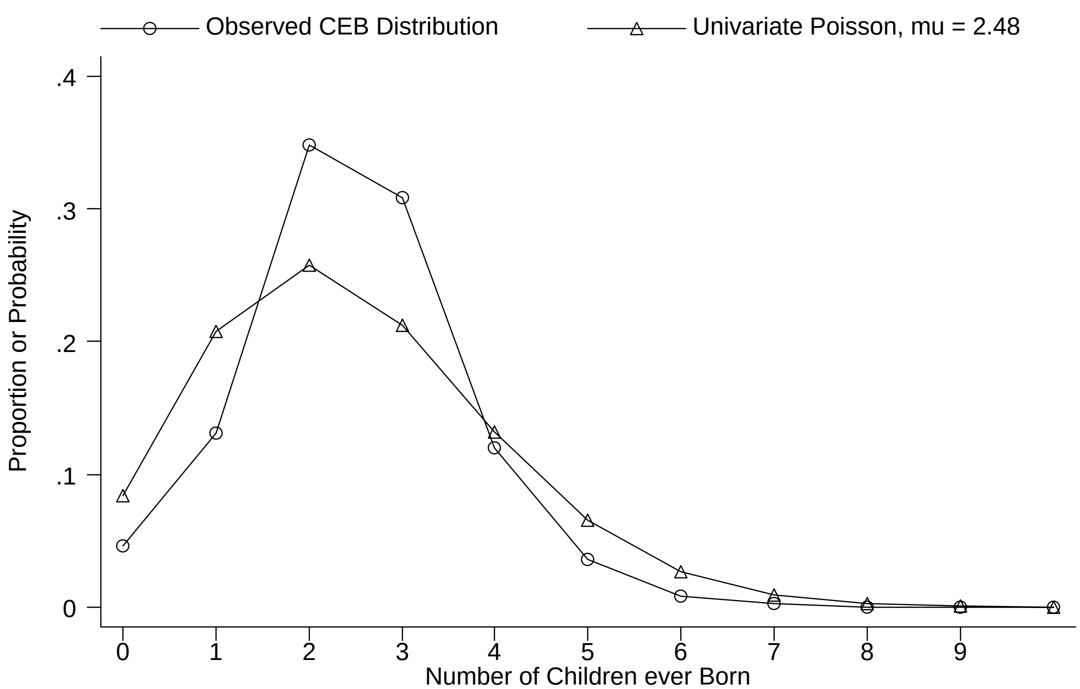
I will use only one type of robust regression. This method is based on iteratively reweighted least squares (IRLS) with Huber and bi-weight functions, instead of ordinary least squares (OLS) regression.

Poisson Model

The dependent variable of children ever born is a count variable; that is, it is a "nonnegative integer-valued random variable" (Cameron and Trivedi 1998, p. 1). In the data, this variable is not normally distributed. It ranges from 0 to 15 in China and 0 to 9 in Taiwan, and is quite skewed to the left (please refer to Figure 5.2). In data such as these, Cameron and Trivedi caution that "common regression estimators and models,



CEB Distribution and Poisson in 1988 China Fertility Survey



CEB Distribution and Poisson Distribution in 1992 Taiwan KAP

Source: SFPCC 1989, and TAPIFP 1992

Figure 5.3 Observed CEB Distribution and Poisson Distribution for China and Taiwan such as ordinary least squares (OLS) in the linear regression model, ignore the restricted support for the dependent variables" (1998, p. 2). Therefore, to avoid producing biased, inefficient, and inconsistent estimates, maximum likelihood Poisson regression will be used instead of OLS regression. For graphic verification, the distribution of the CEB variables is examined. Indeed the observed distribution of the CEB variables for China and Taiwan in Figure 5.2 resembles a Poisson distribution (green line).Also graphed in Figure 5.2 is the univariate Poisson distribution (brown line) for the China and Taiwan means, according to the univariate Poisson formula:

$$\Pr(Y = y) = \frac{\exp(-\mu)\,\mu^{y}}{y!}, \quad y = 0, 1, 2, \ldots$$

where Pr is the Poisson probability for each value of the count variable, and μ is the mean of the univariate Poisson distribution. In the case of the Poisson distribution shown in Figure 5.2, μ=2.71 for China and μ=2.48 for Taiwan, and y is the value of the count variable, that is, the number of CEB, ranging from 0 to 9 in Figure 5.2.

The univariate Poisson distribution, Poston (2002b) cautions, should not be expected to perfectly predict the proportions of women at each count of CEB, because this distribution does not take into account the heterogeneity of the women. Also, Poston warns, although use of the Poisson regression model is appropriate when the mean and the variance of the count distribution are similar, it is less applicable when the variance of the distribution exceeds the mean (also called over-dispersion). The distributions of the CEB data for China and Taiwan are close enough to Poisson distributions, however, to justify use of Poisson regression as a modeling strategy. In the actual estimation of the

Poisson regression models in Chapter VI, I introduce a Poisson Goodness of Fit χ^2 statistic that functions formally to test whether the CEB data are Poisson distributed.

In a Poisson regression model, the dependent variable (the number of events, i.e., the number of children ever born) is a nonnegative integer and has a Poisson distribution with a conditional mean that depends on the characteristics (the independent variables) of the women. The model therefore incorporates observed heterogeneity according to the following structural equation:

$$\mu_i = \exp\,(a + X_{1i}\, b_1 + X_{2i}\, b_2 + ... + X_{ki}\, b_k)$$

$$\mu_i = \exp(a + X_{1i} b_1 + X_{2i} b_2 + ... X_{ki} b_k)$$

where μ_i is the expected number of children ever born for the ith woman; $X1i$, $X2i$ ... Xki are her characteristics; and *a, b1, b2 ... bk* are the Poisson regression coefficients.

The Poisson regression model is a nonlinear model, predicting for each individual woman the number of children she has had ever born to her, μ_i. The X variables are related to μ_i nonlinearly.

Logistic Model

Logistic regression is applied to examine the probabilities that respondents use sterilization as their contraceptive method. This is a dummy variable with a binary category, and the maximum-likelihood **(ML)** method is used. In the logistic regression model, the maximum likelihood method, which yields values for the unknown parameters that maximize the probability of obtaining the observed set of data, provides the foundation for estimating the probabilities of the chosen dependent variables.

Mathematically, it is specified as

$$Log\ \{Prob(using\ sterilization)/Prob(not\ using\ sterilization)\} = b_0 + b_1X_1 + \ldots b_pX_p$$

or $$\frac{P}{1-P} = e^{a+b_1X_1+\ldots b_pX_u}$$

where b_0 and b_1 represent coefficients of log odds and X_1 represents the predictor variables. The logistic coefficients can be interpreted as the change in the log odds (or odds) associated with a one-unit change in the independent variable. The odds ratio is the probability that the specified change in the independent variable will occur, divided by the probability that it will *not* occur (Hosmer and Lemeshow 1989). Instead of assuming that the relationship between p and X_i is linear, we instead assume that the relationship is linear between the logarithm of the odds of success, i.e., $\ln[p/(1-p)]$, and X_i .

Survival Analysis

Survival analysis, also called event history analysis, has the advantage of modeling time-dependent variables and their duration. Specifically, it focuses on the analysis of the duration of the "nonoccurrence of certain events" during the risk period; stated differently, it focuses on whether an event occurs during the risk period. Event history models the “instantaneous probability” (Tuma and Hannan 1984) of having a certain event at time *t* given that the event has not occurred *before* time *t*. This probability is called the “hazard rate” or “risk.”

The hazard model is computed as follows:

$$hj(t|t_0)=\lim_{\Delta t \to 0} \frac{Sj(t|t_0)- Sj(t+\Delta t|t_0)}{Sj(t|t_0)\,\Delta t}$$

where *hj* denotes the risk, and *Sj* denotes the survival function, which is the probability that the event does not occur at time *t*. In other words, the survival function (*Sj*) is the ratio of all people who do not have the event at time *t* divided by the number of people at risk at time *t*.

One major advantage of the hazard-rate model in analysis of duration data, according to Yamaguchi (1991) is its capacity to handle various kinds of “censored” observations. That is, it allows estimation of the number of people who do not experience the event, thereby making the event-history models statistically more powerful. Because the observation period of each analysis is always limited, the concept of censoring is introduced to refer to lack of complete information about the duration of the risk period (Yamaguchi 1991, p. 3). More precisely, censoring occurs when we have some information about the individual’s survival time, but the exact survival time is unknown. For example, OLS can model variation in the length of the interval that precedes a birth (i.e., the birth interval), but women who had not given birth by the time of the interview would be excluded. Conversely, a logistic model can examine the probability of having or not having a particular birth, but it cannot include variation in the *timing* of having the birth. This limits its statistical power (Yamaguchi 1991).

In my research, I assume that a Chinese couple would not be at risk for pregnancy until they are married, even though the period in which a couple is at risk is for pregnancy could in actuality begin before the marriage date. I try to identify the effects of women's characteristics and of their living patterns on their hazard of having the first, second and third childbirths, respectively. For the first scenario of childbirth, once women were married, then their risk period started during the observation period and ended either with the event of first childbirth or with the moment when the survey ended in August 1988. For the second scenario of childbirth, once women had their first childbirth, then their risk period started during the observation period and ended either with the event of second childbirth or without the event of second childbirth when the survey was done. Similarly, in the third scenario of childbirth, once women had their second childbirth, their risk period started during the observation period and closed either when the event of third childbirth happened or when the survey terminated.

Several statistical models are available for doing survival analysis. Here, the Cox proportional hazard model is chosen to investigate the effects of the variables in question. Unlike other models that are parametric, the Cox model is only partially parametric, which means that it does not specify how time distribution is to be modeled. The Cox proportional hazards model is a partial-likelihood estimation method. According to Yamaguchi (1991, p. 101), it is one of the most popular event-history analysis methods in the social sciences, mainly because the investigator does not have to model time.

The two main advantages of the Cox continuous-time proportional hazards model over ML continuous-time models and discrete-time models are discussed by Yamaguchi (1991). As noted, the first and most significant advantage is that the Cox model allows the equation to assume time dependence but does not need to specify how time enters the equation can assume time dependence without having to specify its form (Yamaguchi, 1991, p. 102). In contrast to the ML continuous model that requires us to specify how time would enter the equation, the Cox model is solved using a partial likelihood (PL) approach, which gives it its advantage the PL method. When all of the dependent variables are time-dependent (which means that the values of the independent variables do not change over time) the Cox model may be represented as follows:

$$\text{Log } h(t) = \log h0\ (t) + b1X1 + b2X2 + \ldots + BiXi$$

where log *h(t)* is the hazard rate (or, hazard function); it expresses the instantaneous risk of occurrence of the event of interest during the interval from *t* to *t*+*s*, given that the event did not occur before time *t* (Allison 1984, p. 34). Rather actually being a probability, it is a rate. Therefore, the values of the hazard function range from zero to infinity: *h0*(*t*) is any function of time *t* which need not be specified; and *X1* to *Xi* are independent variables.

The form of Cox's model can alternatively be represented as

$$R(t)=q(t)f(x(t))$$

In other words, Cox's model assumes that each transition rate R(t) has two components. One is an unknown, possibly time-dependent nuisance function q(t) that affects the rate of every member of the population in the same way. The second is f(x(t)), which is assumed to depend on a vector of observed causal variables x(t), on parameters to be estimated, and possibly to depend also on time t.

The partially parametric approach does not require specification for q(t); however, it does require parametric assumptions about the dependence of f(x(t)) on the observed variables x(t). Usually it is assumed that the rate of an event is a log-linear function of the current values of observed variables:

$$F(x(t))=e^{\alpha x(t)}$$

where α is an unknown vector of parameters to be estimated.

The second advantage of Cox's method is that it has the ability to use stratified models that permit us to control for categorical independent variables that may interact with time in a complicated fashion, yet it does not require that we specify the form of the interaction effects. This is an advantage when we are not interested in the effects of given specific covariates and their interactions with time, but rather the effects of other covariates. A stratified model allows us to control for the categorical variables without stratifying the complicated interaction between those variables and time (Yamaguchi 1991, p. 102). Running a stratified model "is equivalent to estimating separate Cox proportional hazard models under the constraint that the coefficients, but not the baseline hazard functions, are equal"(STATA 6.0 1999, p. 380). Because there are different baseline hazard functions, the fitted stratified Cox model will yield different estimated survival curves for any two groups compared. To test for the equality of survivor functions for several categorical variables such as rural, farmer, three generation household, I will use log-rank test, which tests the null hypothesis of a common survival curve for the two groups of subjects (Kleinbaum 1996; STATA 6.0 1999, p. 460).

Hierarchical Generalized Linear Model (HGLM)

One of the basic problems of the social sciences, Bryk and Raudenbush (1992) observed, is relating properties of individuals to the properties of the groups and structures in which the individuals function. Individuals are not scattered in the society, but function within specific differentiated groups, and each group has its own characteristics that not only distinguish it from other groups, but also generate effects on the individuals who belong to it. When individuals are grouped into larger units, each unit comprises a number of individuals, and the data structures become nested or hierarchical. But when values of higher-order variables are assigned to an individual, the classical assumption of independence is violated. The main problem with this kind of disaggregation is that although individuals in different groups are independent, individuals in each specific group share the same values on the group variable. It also does not make sense to aggregate the individual-level variables to the higher level, because in so doing a large portion of within-group information will go unobserved. Also, relations among aggregated variables are often stronger and different from the relations at the individual level (Bryk and Raudenbush 1992).

Over the last two decades, multilevel models (i.e., models characterized by the advantages of modeling social-scientific data within a hierarchical nested structure) have become widely used and accepted (Poston 2002a). These models are also called contextual models, hierarchical linear models, hierarchical liner regression, random coefficients models, hierarchical mixed linear models, or Bayesian linear models (Kreft et al. 1990). Traditionally, the micro-level coefficient is expressed as an exact function of macro-level variables and are known as fixed effects. The new models, by specifying the regression coefficients as random effects, contain error terms in the macro equations. The inclusion of these error terms at the macro-level implies a more complex error structure in the single-equation version of the multilevel model.

The purposes of using multilevel modeling, as suggested by DiPrete and Forristal (1994), are to explain micro-level outcomes in two ways: (1) by showing as a function of context the parameters of models specified at the micro-level and (2) by expressing micro-macro interactions in terms of characteristics of the context. By these new techniques, "we can now pose hypotheses about relations occurring at each level and across levels and also assess the amount of variation at each level. . . . The applications to date have been encouraging in that they have both afforded an exploration of new questions and provided some empirical results that might otherwise have gone undetected" (Bryk and Raudenbush 1992, p. 3).

Hierarchical linear modeling (HLM), first introduced by Bryk and Raudenbush in 1988, is one of several kinds of hierarchical models for analyzing hierarchically structured data. Instead of using standard HLM, which assumes a normal distribution of the dependent variable, I will estimate two non-linear models. First, given the binary nature of the dependent variable and the two levels of predictors used in the analysis, I will use the Bernoulli (or binary) method for the dependent variable--sterilization status.

Second, as mentioned in the discussion of the Poisson analysis, the dependent variable of children ever born, which Bryk and his colleagues (1996) call count data, is skewed. Therefore, a Poisson non-linear model is used for the dependent variable of children ever born.

The HGLM, also known as the generalized linear model with random effects (Schall 1991) or the generalized linear mixed model (cf. Berslow and Clayton 1993) is preferred over the standard HLM when the dependent variables are binary or counts. As Bryk and his colleagues (1996) observed, the standard HLM is appropriate for two- and three-level data when the random effects at each level are normally distributed or when the outcome variable is continuous. However, when the assumption of normality at level-1 is not realistic, as in the case of CEB and contraceptive usage, the use of standard HLM would be biased. Consequently, the assumption of normal distribution with homogeneous variance is not satisfied (Bryk et al. 1996; Hosmer and Lemeshow 1989). In fact, Bryk and his colleagues (1996) considered the standard HLM model a special case of Hierarchical Generalized Linear Model (HGLM) in which the sampling model is normal and the link function is the identity link.

When the level-1 sampling model is binomial, as for the dependent variable sterilization, HGLM uses the logit link function:

$$\eta_{ij} = \log \left(\frac{\varphi_{ij}}{1-\varphi_{ij}} \right)$$

In the level-1 model, η_{ij} is the predicted log-odds of success, or the logit. In the level-1 model, ϕ_{ij} is the probability of success. If, for example, ϕ_{ij} is 0.5, the odds of success is 1.0, and the log-odds, or the logit, is zero. When the probability of success is less than 0.5, the odds are less than one and the logit is negative. Conversely, and when the probability is greater than 0.5, the odds are greater than unity and the logit is positive. The Bernoulli nonlinear approach in HGLM will be estimated for the logit link function.

When the level-1 sampling model is Poisson, such as the values of CEB, HGLM uses the log link function, expressed as

$$\eta_{ij} = \log(\lambda_{ij})$$

In other words, η_{ij} is the log of the event rate. When the event rate, λ_{ij}, is one, the log is zero. When the event rate is less than one, the log is negative; when the event rate is greater than one, the log is positive. Thus, whereas λ_{ij} is constrained to be non-negative, η_{ij} can be any real value. The Poisson nonlinear approach in HGLM will be estimated for the log link function.

In Chapter VI, I use two separate steps to process the multilevel analysis. The first step is the One-way ANOVA Model and the second step is the Intercept- And Slopes-As-Outcomes Model (Arnold 1992).

One-way ANOVA Model

I begin the analysis of the data with a simple model without predictors at either level: a one-way ANOVA model. This analysis makes available baseline information about the outcome variables of CEB and sterilization status. Specifically, it shows how much variation is at the individual-level and how much is at the province-level or county-level. In this way, the within-province and between-province variance in the probability for each value of CEB or in the risk of sterilization can be compared. According to Bryk and Raudenbush (1992), the One-way ANOVA results offer the following introductory information about the possibility of the numbers of CEB or sterilizations in the 27 provinces of China or the 23 counties of Taiwan: (1) an estimate of the grand mean; (2) an estimate of the level-2 variance component, which can be used to calculate the intra-class correlation based on the concept of a "latent variable"; (3) a measure of the reliability of each state's sample mean likelihood as an estimate of its true population mean; and (4) a test of the hypothesis that all provinces have the same risk of sterilization, or the same rate of CEB.

The level-1 one-way ANOVA model is basically:

$$\eta_{ij} = \beta_{0j}$$

where η_{ij} is the predicted log-odds of success, i.e., the logit of being sterilized, or the predicted log of the CEB event rate.

β_{0j} is the intercept of province j of China or county j of Taiwan from the aggregate-level model specified below; it is the average log of the CEB event rate or average log odds of sterilization for the jth province or county.

The level-2 one-way ANOVA model is denoted as:

$$\beta_{0j} = \gamma_{00} + \mu_{0j}$$

where γ_{00} is the average log of the CEB event rate or the average log-odds of being sterilized across all provinces in China or all counties in Taiwan, while $\boldsymbol{\mu_0}$ is a random error associated with province j or county j and has a normal distribution with a mean of 0 and a constant variance of τ_{00}. The value of τ_{00} is the variance between provinces or counties in province-or-county-average log of the CEB event rate or province-or-county-average log odds of sterilization. As mentioned before, this aggregate-level equation is estimated in order to provide the intercepts for each of the provinces or counties. Each province-or-county-average log of the CEB event rate or province-or-county-average log odds of sterilization is a function of the grand average log of the CEB event rate or log odds of sterilization, together with a random error.

By merging the between-state equation into the within-state equation, a combined model is derived:

$$\eta_{ij} = \gamma_{00} + \mu_{0j}$$

This equation is equivalent to a one-way ANOVA with grand average log of the CEB event rate or grand average log-odds of sterilization. Because no predictor is specified at either level, the model is fully unconditional. It provides information that can be used to calculate the variability occurring at each of the two levels, and also the reliability of each state's sample mean as an estimate of its true population mean. All of these features contribute to a useful set of preliminary information in the hierarchical data analysis. If the variance between provinces (or counties) is not significantly different from zero, then there is no need to estimate a multi-level model.

Intercept- and Slopes-As-Outcomes Model

The Intercept- and Slopes-As-Outcomes Model estimates the variability of intercepts and slopes across level-2 units. The individual women are the level-1 units of analysis, and the states are the level-2 analysis units.

To enhance the interpretability of the province or county effects, the individual covariates are centered around the group means, while the state-level variables are centered around the grand mean. With mean centering, the individual-level intercept becomes the average log odds for the group in a province or county, adjusted for the set of individual-level covariates. In addition, by centering the variables around their respective state means, β_{0j} denotes the average log odds or log of the event rate in province or county j. In this way, the between-province or between-state equation for β_{0j} stands for the regression of average log odds on state characteristics and is equivalent to using the state as the unit of analysis.

I have included below an example using as the dependent variable Chinese women's sterilization status. The Bernoulli nonlinear approach in HGLM for the logit link function is displayed.

The level-1 structural model is as follows (bold: group-mean centering):

$$\eta_{ij} = \log \left(\frac{\varphi_{ij}}{1-\varphi_{ij}} \right) =$$

$$\beta_{0j} + \beta_{0j}(\mathbf{Rural})_{ij} + \beta_{2j}(\mathbf{Education})_{ij} + \beta_{3j}(\mathbf{Han})_{ij} + \beta_{4j}(\mathbf{HAge})_{ij} +$$

$\beta_{5j}(\mathbf{Myears})_{ij}+\beta_{6j}(\mathbf{ThreeG})_{ij}+\beta_{7j}(\mathbf{Farmer})_{ij}+\beta_{8j}(\mathbf{Nopap})_{ij}+\ \beta_{9j}(\mathbf{Noindex})_{ij}+$
r_{ij}

where η_{ij} is the log odds of sterilization for women i in China's province j or Taiwan's county j; β_{0j} is the intercept, or the average log odds of sterilization in China's province j or Taiwan's county j; and β_{0j} , β_{1j} .. β_{9j} are the coefficients associated with level-1 variables Rural, Education, Han, HAge, Myears, ThreeG, Farmer, Nopap, and Noindex for Women i in China's province j, respectively; or the slopes of independent variables on the log odds of sterilization.

The level-2 structural model is specified as (Italic bold: grand-mean centering):

$\beta_{0j}=\gamma_{00}+\gamma_{01}(\boldsymbol{FOPR})_j+\gamma_{02}(\boldsymbol{IMR})_j+\gamma_{03}(\boldsymbol{TFR})_j+\gamma_{04}(\boldsymbol{FDR})_j+\gamma_{05}(\boldsymbol{AGR})_j+$

$\gamma_{06}(\boldsymbol{FCR})_j+\gamma_{07}(\boldsymbol{PAPR})_j+\mu_{0j}$

$\beta_{1j}=\gamma_{10}+\gamma_{11}(\boldsymbol{FOPR})_j+\gamma_{12}(\boldsymbol{IMR})_j+\gamma_{13}(\boldsymbol{TFR})_j+\gamma_{14}(\boldsymbol{FDR})_j+\gamma_{15}(\boldsymbol{AGR})_j+$

$\gamma_{16}(\boldsymbol{FCR})_j+\gamma_{17}(\boldsymbol{PAPR})_j+\mu_{1j}$

$\beta_{2j}=\gamma_{20}+\gamma_{21}(\boldsymbol{FOPR})_j+\gamma_{22}(\boldsymbol{IMR})_j+\gamma_{23}(\boldsymbol{TFR})_j+\gamma_{24}(\boldsymbol{FDR})_j+\gamma_{25}(\boldsymbol{AGR})_j+$

$\gamma_{26}(\boldsymbol{FCR})_j+\gamma_{27}(\boldsymbol{PAPR})_j+\mu_{2j}$

$\beta_{3j}=\gamma_{30}+\gamma_{31}(\boldsymbol{FOPR})_j+\gamma_{32}(\boldsymbol{IMR})_j+\gamma_{33}(\boldsymbol{TFR})_j+\gamma_{34}(\boldsymbol{FDR})_j+\gamma_{35}(\boldsymbol{AGR})_j+$

$\gamma_{36}(\boldsymbol{FCR})_j+\gamma_{37}(\boldsymbol{PAPR})_j+\mu_{3j}$

$\beta_{4j}=\gamma_{40}+\gamma_{41}(\boldsymbol{FOPR})_j+\gamma_{42}(\boldsymbol{IMR})_j+\gamma_{43}(\boldsymbol{TFR})_j+\gamma_{44}(\boldsymbol{FDR})_j+\gamma_{45}(\boldsymbol{AGR})_j+$

$\gamma_{46}(\boldsymbol{FCR})_j+\gamma_{47}(\boldsymbol{PAPR})_j+\mu_{4j}$

$$\beta_{5j}=\gamma_{50}+\gamma_{51}(\boldsymbol{FOPR})_j+\gamma_{52}(\boldsymbol{IMR})_j+\gamma_{53}(\boldsymbol{TFR})_j+\gamma_{54}(\boldsymbol{FDR})_j+\gamma_{55}(\boldsymbol{AGR})_j+$$

$$\gamma_{56}(\boldsymbol{FCR})_j+\gamma_{57}(\boldsymbol{PAPR})_j+\mu_{5j}$$

$$\beta_{6j}=\gamma_{60}+\gamma_{61}(\boldsymbol{FOPR})_j+\gamma_{62}(\boldsymbol{IMR})_j+\gamma_{63}(\boldsymbol{TFR})_j+\gamma_{64}(\boldsymbol{FDR})_j+\gamma_{65}(\boldsymbol{AGR})_j+$$

$$\gamma_{66}(\boldsymbol{FCR})_j+\gamma_{67}(\boldsymbol{PAPR})_j+\mu_{6j}$$

$$\beta_{7j}=\gamma_{70}+\gamma_{71}(\boldsymbol{FOPR})_j+\gamma_{72}(\boldsymbol{IMR})_j+\gamma_{73}(\boldsymbol{TFR})_j+\gamma_{74}(\boldsymbol{FDR})_j+\gamma_{75}(\boldsymbol{AGR})_j+$$

$$\gamma_{76}(\boldsymbol{FCR})_j+\gamma_{77}(\boldsymbol{PAPR})_j+\mu_{7j}$$

$$\beta_{8j}=\gamma_{80}+\gamma_{81}(\boldsymbol{FOPR})_j+\gamma_{82}(\boldsymbol{IMR})_j+\gamma_{83}(\boldsymbol{TFR})_j+\gamma_{84}(\boldsymbol{FDR})_j+\gamma_{85}(\boldsymbol{AGR})_j+$$

$$\gamma_{86}(\boldsymbol{FCR})_j+\gamma_{87}(\boldsymbol{PAPR})_j+\mu_{8j}$$

$$\beta_{9j}=\gamma_{90}+\gamma_{91}(\boldsymbol{FOPR})_j+\gamma_{92}(\boldsymbol{IMR})_j+\gamma_{93}(\boldsymbol{TFR})_j+\gamma_{94}(\boldsymbol{FDR})_j+\gamma_{95}(\boldsymbol{AGR})_j+$$

$$\gamma_{96}(\boldsymbol{FCR})_j+\gamma_{97}(\boldsymbol{PAPR})_j+\mu_{9j}$$

where

γ_{00} is the expected intercept or the average log odds of sterilization for provinces,

γ_{10}, γ_{20}.... γ_{90} are the expected slopes for a province with values of zero on the level-2 independent variables FOPR, IMR, TFR, FDR, AGR, FCR, and PAPR, respectively,

γ_{01}, γ_{02}, γ_{03}....... γ_{95}, γ_{96}, and γ_{97} are the regression coefficients associated with mean values of level-2 variables FOPR, IMR, TFR, FDR, AGR, FCR, and PAPR, respectively,

$\mu_{0j}, \mu_{1j} ...... \mu_{9j}$ are the unique random effects associated with province j.

When the level-2 equations are replaced within the level-1 model equation, the following integrated equation results:

$$\eta_{ij} = \log \left(\frac{\varphi_{ij}}{1-\varphi_{ij}} \right) =$$

$$\gamma_{00} + \gamma_{01}(\boldsymbol{FOPR})_j + \gamma_{02}(\boldsymbol{IMR})_j + \gamma_{03}(\boldsymbol{TFR})_j + \gamma_{04}(\boldsymbol{FDR})_j + \gamma_{05}(\boldsymbol{AGR})_j + \gamma_{06}(\boldsymbol{FCR})_j + \gamma_{07}(\boldsymbol{PAPR})_j + \gamma_{10}(\mathbf{Rural})_{ij} + \gamma_{11}(\boldsymbol{FOPR})_j(\mathbf{Rural})_{ij} + \gamma_{12}(\boldsymbol{IMR})_j(\mathbf{Rural})_{ij} + \gamma_{13}(\boldsymbol{TFR})_j(\mathbf{Rural})_{ij} + \gamma_{14}(\boldsymbol{FDR})_j(\mathbf{Rural})_{ij} + \gamma_{15}(\boldsymbol{AGR})_j(\mathbf{Rural})_{ij} + \gamma_{16}(\boldsymbol{FCR})_j(\mathbf{Rural})_{ij} + \gamma_{17}(\boldsymbol{PAPR})_j(\mathbf{Rural})_{ij} + \gamma_{20}(\mathbf{Education})_{ij} + \gamma_{21}(\boldsymbol{FOPR})_j(\mathbf{Education})_{ij} + \gamma_{22}(\boldsymbol{IMR})_j(\mathbf{Education})_{ij} + \gamma_{23}(\boldsymbol{TFR})_j(\mathbf{Education})_{ij} + \gamma_{24}(\boldsymbol{FDR})_j(\mathbf{Education})_{ij} + \gamma_{25}(\boldsymbol{AGR})_j(\mathbf{Education})_{ij} + \gamma_{26}(\boldsymbol{FCR})_j(\mathbf{Education})_{ij} + \gamma_{27}(\boldsymbol{PAPR})_j(\mathbf{Education})_{ij} + \gamma_{30}(\mathbf{Han})_{ij} + \gamma_{31}(\boldsymbol{FOPR})_j(\mathbf{Han})_{ij} + \gamma_{32}(\boldsymbol{IMR})_j(\mathbf{Han})_{ij} + \gamma_{33}(\boldsymbol{TFR})_j(\mathbf{Han})_{ij} + \gamma_{34}(\boldsymbol{FDR})_j(\mathbf{Han})_{ij} + \gamma_{35}(\boldsymbol{AGR})_j(\mathbf{Han})_{ij} + \gamma_{36}(\boldsymbol{FCR})_j(\mathbf{Han})_{ij} + \gamma_{37}(\boldsymbol{PAPR})_j(\mathbf{Han})_{ij} + \gamma_{40}(\mathbf{HAge})_{ij} + \gamma_{41}(\boldsymbol{FOPR})_j(\mathbf{HAge})_{ij} + \gamma_{42}(\boldsymbol{IMR})_j(\mathbf{HAge})_{ij} + \gamma_{43}(\boldsymbol{TFR})_j(\mathbf{HAge})_{ij} + \gamma_{44}(\boldsymbol{FDR})_j(\mathbf{HAge})_{ij} + \gamma_{45}(\boldsymbol{AGR})_j(\mathbf{HAge})_{ij} + \gamma_{46}(\boldsymbol{FCR})_j(\mathbf{HAge})_{ij} + \gamma_{47}(\boldsymbol{PAPR})_j(\mathbf{HAge})_{ij} + \gamma_{50}(\mathbf{Myears})_{ij} + \gamma_{51}(\boldsymbol{FOPR})_j(\mathbf{Myears})_{ij} + \gamma_{52}(\boldsymbol{IMR})_j(\mathbf{Myears})_{ij} + \gamma_{53}(\boldsymbol{TFR})_j(\mathbf{Myears})_{ij} + \gamma_{54}(\boldsymbol{FDR})_j(\mathbf{Myears})_{ij} + \gamma_{55}(\boldsymbol{AGR})_j(\mathbf{Myears})_{ij} + \gamma_{56}(\boldsymbol{FCR})_j(\mathbf{Myears})_{ij} + \gamma_{57}(\boldsymbol{PAPR})_j(\mathbf{Myears})_{ij} + \gamma_{60}(\mathbf{ThreeG})_{ij} + \gamma_{61}(\boldsymbol{FOPR})_j(\mathbf{ThreeG})_{ij} + \gamma_{62}(\boldsymbol{IMR})_j(\mathbf{ThreeG})_{ij} + \gamma_{63}(\boldsymbol{TFR})_j(\mathbf{ThreeG})_{ij} + \gamma_{64}(\boldsymbol{FDR})_j(\mathbf{ThreeG})_{ij} + \gamma_{65}(\boldsymbol{AGR})_j(\mathbf{ThreeG})_{ij} + \gamma_{66}(\boldsymbol{FCR})_j(\mathbf{ThreeG})_{ij} + \gamma_{67}(\boldsymbol{PAPR})_j(\mathbf{ThreeG})_{ij} + \gamma_{70}(\mathbf{Farmer})_{ij} + \gamma_{71}(\boldsymbol{FOPR})_j(\mathbf{Farmer})_{ij} + \gamma_{72}(\boldsymbol{IMR})_j(\mathbf{Farmer})_{ij} + \gamma_{73}(\boldsymbol{TFR})_j(\mathbf{Farmer})_{ij} + \gamma_{74}(\boldsymbol{FDR})_j(\mathbf{Farmer})_{ij} + \gamma_{75}(\boldsymbol{AGR})_j(\mathbf{Farmer})_{ij} + \gamma_{76}(\boldsymbol{FCR})_j(\mathbf{Farmer})_{ij} + \gamma_{77}(\boldsymbol{PAPR})_j(\mathbf{Farmer})_{ij} + \gamma_{80}(\mathbf{Nopap})_{ij} + \gamma_{81}(\boldsymbol{FOPR})_j(\mathbf{Nopap})_{ij} + \gamma_{82}(\boldsymbol{IMR})_j(\mathbf{Nopap})_{ij} + \gamma_{83}(\boldsymbol{TFR})_j(\mathbf{Nopap})_{ij} + \gamma_{84}(\boldsymbol{FDR})_j(\mathbf{Nopap})_{ij} +$$

$$\gamma_{85}(\boldsymbol{AGR})_j(\textbf{Nopap})_{ij} + \gamma_{86}(\boldsymbol{FCR})_j(\textbf{Nopap})_{ij} + \gamma_{87}(\boldsymbol{PAPR})_j(\textbf{Nopap})_{ij} + \gamma_{90}(\textbf{Noindex})_{ij} + \gamma_{91}(\boldsymbol{FOPR})_j(\textbf{Noindex})_{ij} + \gamma_{92}(\boldsymbol{IMR})_j(\textbf{Noindex})_{ij} + \gamma_{93}(\boldsymbol{TFR})_j(\textbf{Noindex})_{ij} + \gamma_{94}(\boldsymbol{FDR})_j(\textbf{Noindex})_{ij} + \gamma_{95}(\boldsymbol{AGR})_j(\textbf{Noindex})_{ij} + \gamma_{96}(\boldsymbol{FCR})_j(\textbf{Noindex})_{ij} + \gamma_{97}(\boldsymbol{PAPR})_j(\textbf{Noindex})_{ij} + \mu_{9j} + \mu_{8j} + \mu_{7j} + \mu_{6j} + \mu_{5j} + \mu_{4j} + \mu_{3j} + \mu_{2j} + \mu_{1j} + \mu_{0j}$$

This model asserts that an individual woman's average risk of being sterilized is a function of the following:

- the overall effect γ_{00}, or the expected log-odds of sterilization for a Chinese

woman with values of zero on the predictors: in other words, for a non-Han, non-farmer Chinese woman without any years of schooling, without living in a three-generation household, with husband aged zero, with a zero marriage year, without taking a one-child certificate, and without violating the childbirth quota. This expected log-odds of sterilization may be thought of as a probability of sterilization, following the formula: 1 / (1+ exp {- predicted log-odds coefficient}).

- the main effect of FOPR- Female Occupation Participation Rate, γ_{01}
- the main effect of IMR- 0-year-old-age Mortality Rate, γ_{02}
- the main effect of TFR- Total Fertility Rate, γ_{03}
- the main effect of FDR- Female Divorce Rate, γ_{04}
- the main effect of AGR- Agricultural Participation Rate, γ_{05}
- the main effect of FCR- Female College Graduation Rate, γ_{06}
- the main effect of PAPR- One-child Certificates Prevalence Rate, γ_{07}

- the main effect of Rural, γ_{10}
- the main effect of Education, γ_{20}
- the main effect of HAN, γ_{30}
- the main effect of HAge, γ_{40}
- the main effect of Myears, γ_{50}
- the main effect of ThreeG, γ_{60}
- the main effect of Farmer, γ_{70}
- the main effect of Nopap, γ_{80}
- the main effect of Noindex, γ_{90}

and the following cross-level interactions engaging both level-1 and level-2 characteristics:

- γ_{11} is the FOPR effect of Rural-Sterilization slope,
- γ_{12} is the IMR effect of Rural-Sterilization slope,
- γ_{13} is the TFR effect of Rural-Sterilization slope,
- γ_{14} is the FDR effect of Rural-Sterilization slope,
- γ_{15} is the AGR effect of Rural-Sterilization slope,
- γ_{16} is the FCR effect of Rural-Sterilization slope,
- γ_{17} is the PAPR effect of Rural-Sterilization slope,

- γ_{21} is the FOPR effect of Education-Sterilization slope,
- γ_{22} is the IMR effect of Education-Sterilization slope,
- γ_{23} is the TFR effect of Education-Sterilization slope,
- γ_{24} is the FDR effect of Education-Sterilization slope,
- γ_{25} is the AGR effect of Education-Sterilization slope,
- γ_{26} is the FCR effect of Education-Sterilization slope,
- γ_{27} is the PAPR effect of Education-Sterilization slope,
- γ_{31} is the FOPR effect or Han-Sterilization slope,
- γ_{32} is the IMR effect of Han-Sterilization slope,
- γ_{33} is the TFR effect of Han-Sterilization slope,
- γ_{34} is the FDR effect of Han-Sterilization slope,
- γ_{35} is the AGR effect of Han-Sterilization slope,
- γ_{36} is the FCR effect of Han-Sterilization slope,
- γ_{37} is the PAPR effect of Han-Sterilization slope,
- γ_{41} is the FOPR effect of HAge-Sterilization slope,
- γ_{42} is the IMR effect of HAge-Sterilization slope,
- γ_{43} is the TFR effect of HAge-Sterilization slope,
- γ_{44} is the FDR effect of HAge-Sterilization slope,

- γ_{45} is the AGR effect of HAge-Sterilization slope,
- γ_{46} is the FCR effect of HAge-Sterilization slope,
- γ_{47} is the PAPR effect of HAge-Sterilization slope,
- γ_{51} is the FOPR effect of Myears-Sterilization slope,
- γ_{52} is the IMR effect of Myears-Sterilization slope,
- γ_{53} is the TFR effect of Myears-Sterilization slope,
- γ_{54} is the FDR effect of Myears-Sterilization slope,
- γ_{55} is the AGR effect of Myears-Sterilization slope,
- γ_{56} is the FCR effect of Myears-Sterilization slope,
- γ_{57} is the PAPR effect of Myears-Sterilization slope,
- γ_{61} is the FOPR effect of ThreeG-Sterilization slope,
- γ_{62} is the IMR effect of ThreeG-Sterilization slope,
- γ_{63} is the TFR effect of ThreeG-Sterilization slope,
- γ_{64} is the FDR effect of ThreeG-Sterilization slope,
- γ_{65} is the AGR effect of ThreeG-Sterilization slope,
- γ_{66} is the FCR effect of ThreeG-Sterilization slope,
- γ_{67} is the PAPR effect of ThreeG-Sterilization slope,
- γ_{71} is the FOPR effect of Farmer-Sterilization slope,

- γ_{72} is the IMR effect of Farmer-Sterilization slope,
- γ_{73} is the TFR effect of Farmer-Sterilization slope,
- γ_{74} is the FDR effect of Farmer-Sterilization slope,
- γ_{75} is the AGR effect of Farmer-Sterilization slope,
- γ_{76} is the FCR effect of Farmer-Sterilization slope,
- γ_{77} is the PAPR effect of Farmer-Sterilization slope,
- γ_{81} is the FOPR effect of Nopap-Sterilization slope,
- γ_{82} is the IMR effect of Nopap-Sterilization slope,
- γ_{83} is the TFR effect of Nopap-Sterilization slope,
- γ_{84} is the FDR effect of Nopap-Sterilization slope,
- γ_{85} is the AGR effect of Nopap-Sterilization slope,
- γ_{86} is the FCR effect of Nopap-Sterilization slope,
- γ_{87} is the PAPR effect of Nopap-Sterilization slope,
- γ_{91} is the FOPR effect of Noindex-Sterilization slope,
- γ_{92} is the IMR effect of Noindex-Sterilization slope,
- γ_{93} is the TFR effect of Noindex-Sterilization slope,
- γ_{94} is the FDR effect of Noindex-Sterilization slope,
- γ_{95} is the AGR effect of Noindex-Sterilization slope,

- γ_{96} is the FCR effect of Noindex-Sterilization slope,
- γ_{97} is the PAPR effect of Noindex-Sterilization slope,

Hierarchical Generalized Linear Modeling is a multilevel modeling procedure that operates across more than one scale or level, so that an overall model can handle both individual and aggregate level data. It makes use of maximum information and is more precise in predicting the outcome with independent variables at different levels. HGLM presents four major advantages:

First, HGLM adopts the empirical Bayes approach (Lindley and Smith 1972) to estimate each level-1 coefficient, with unconditional and conditional shrinkage estimators. Traditional OLS might offer imprecise estimates of each group's regression when a particular level-2 unit has a restricted range on group-level characteristics or a small sample. For instance, Bryk and Raudenbush (1992) found negative estimates of the SES-achievement relationship and apparent dispersion of the OLS estimates of the true slope variance. Whereas unconditional shrinkage pulls each OLS regression line toward the sample average of the regression line, with the empirical Bayes approach, the estimates of each school's regression slope tend to be more concentrated around the sample average.

Second, HGLM can model cross-level effects**.** It can model simultaneously the effects on the dependent variable at both levels, using level-1 characteristics as predictors of the dependent variable at level-1, and level-2 characteristics as predictors of the dependent variable at level 2. In the same overall equation, it can also consider the cross-level effects of a level-2 predictor on the slopes of level-1 predictors on the dependent variable. This modeling framework provides a significant advantage over traditional methods.

Third, HGLM can partition variance-covariance components. HGLM produces the estimations of variance and covariance components with unbalanced, nested data. The multilevel approach enables a decomposition of the variation in the individual level into within- and between-group components (Bryk and Raudenbush 1992). In other words, HGLM can take a level-1 outcome and partition its variance among the units of two levels. That analysis, therefore, identifies differences within the contextual level that conventional models would not have detected, because conventional models do not allow the partitioning of individual variable's variance into within- and between-group components.

Fourth, HGLM can improve estimation of individual effects. For example, some contextual groups are too small to develop reliable predictions by using standard regression methods. By borrowing strength from the entire collection of data, HGLM is able to make efficient use of all available information to provide each minority group with separate prediction equations for large and small groups. The estimator for each contextual group is actually a weighted composite of the information from that group. Hence, HGLM can provide improved estimation of individual effects (Bryk and Raudenbush 1992). In Chapter VI, I will take advantage of these merits of the HGLM approach to examine how the effects of predictors influence the dependent variables of

CEB and sterilization status when between-group and between-individual heterogeneity can be both specified and estimated.

CHAPTER VI

ANALYSIS FINDINGS

In this chapter, to identify the effects of the predictors of CEB, sterilization and childbirth intervals, I present the statistical results of the macro-level analysis from the Robust Regression Model, and the results of the micro-level analysis from the Poisson, Logistic and Survival Models. Then, I proceed into the main focus of the dissertation, the multi-level analysis. I verify that the bivariate assumption of the absence of excessive multicollinearity is met (Belsey 1991; Hamilton 1998). In other words, I verify that none of the independent variables is highly correlated with another independent variable or any linear combination of other independent variables. To accomplish that, I examine the correlation matrix of Table 6.1 and Table 6.2 to detect any high correlation between two variables.

In Table 6.1, based on the bold numbers, which are bigger than 0.7, the following three individual-level variables are highly correlated: Marital Period in Month, Marital years over 14 years, and Wife's Age. Because every woman in this study is married and most older women should have relatively longer marital periods, I exclude Marital Period in Months from further analysis.

Wife's Agricultural Occupation is highly correlated with rural status. At the aggregate level, Agricultural Participation Rate is also highly correlated with Female Occupation Participation Rate, Female College Graduation Rate and One-Child Certificate Rate. So, I exclude Agricultural Participation Rate from further analysis.

In Table 6.2, for the 1992 Taiwan KAP data, the individual-level variables of Marital Period in Months, and Wife's Age are highly correlated. County-level Agricultural Participation Rate also is correlated with Female Divorce Rate, Total Fertility Rate, and Female College Graduation Rate. As with the data for China, I therefore exclude Marital Period in Months and County-level Agricultural Participation Rate.

In addition, in both the China and Taiwan data, women’s educational level and men’s educational level are highly correlated. To avoid interference from the correlation of these two variables, along with wife’s agriculture status and husband’s agriculture status I separate the education-level variable into two models. With other predictors, I classify wife’s education and wife’s agricultural occupation together as Model I, and husband’s education and husband’s agricultural occupation together as Model II.

Robust Regression Model

In order to identify the relationship between predictors and dependent variables at the all macro level, I run robust regression models, using 1990 China province-level data and 1992 Taiwan county-level data. From Table 6.3, in 1990 China province-level data, 0-year-old Mortality Rate, Female Divorce Rate, Female College Graduation Rate and One-Child Certificate Rate pass the significance tests for the number of Children Ever Born (refer to Table 6.3).

Table 6.1 Correlation Matrix of Individual and Provincial Variables in China.

	chil	ste	fst	mst	e1	e2	mag	age	agr	rur	thr	fag	hag	dea	han	nop	noi	tfr	imr	fop	fdr	fcr
chi	1																					
ste	0.19	1																				
fst	0.15	0.86	1																			
mst	0.10	0.37	-0.15	1																		
e1	-0.33	-0.13	-0.10	-0.07	1																	
e2	-0.26	-0.08	-0.06	-0.04	0.48	1																
mag	0.58	0.13	0.09	0.08	-0.40	-0.27	1															
age	0.54	0.10	0.07	0.08	-0.33	-0.22	0.90	1														
agr	0.49	0.15	0.12	0.08	-0.32	-0.22	0.82	0.78	1													
rur	0.14	0.12	0.09	0.07	-0.34	-0.26	0.00	-0.08	0.01	1												
thr	-0.21	-0.11	-0.09	-0.05	0.12	0.11	-0.27	-0.28	-0.21	0.05	1											
fag	0.14	0.13	0.08	0.09	-0.35	-0.25	-0.01	-0.08	0.01	0.73	0.02	1										
hag	0.16	0.11	0.08	0.06	-0.34	-0.30	0.03	-0.04	0.03	0.59	-0.01	0.63	1									
dea	0.58	0.00	-0.02	0.04	-0.19	-0.18	0.30	0.27	0.23	0.10	-0.09	0.10	0.11	1								
han	-0.06	0.06	0.05	0.02	0.05	0.05	0.00	0.02	0.00	-0.03	0.00	-0.04	-0.07	-0.05	1							
nop	0.26	0.21	0.17	0.09	-0.35	-0.25	0.16	0.08	0.18	0.54	0.01	0.50	0.43	0.11	-0.06	1						
noi	-0.41	-0.24	-0.21	-0.10	0.25	0.21	-0.48	-0.45	-0.49	-0.03	0.15	-0.04	-0.05	-0.18	0.00	-0.21	1					
tfr	0.06	-0.08	-0.08	-0.02	-0.15	-0.06	0.01	0.00	0.01	0.18	0.02	0.20	0.12	0.05	0.00	0.13	-0.04	1				
imr	0.20	0.02	-0.03	0.09	-0.15	-0.13	0.04	-0.02	0.05	0.11	-0.02	0.16	0.18	0.17	-0.30	0.15	-0.03	0.12	1			
fop	0.07	-0.04	-0.13	0.16	-0.19	-0.12	0.03	0.02	0.03	0.21	0.00	0.25	0.19	0.11	-0.06	0.14	-0.03	0.51	0.42	1		
fdr	-0.03	-0.06	-0.03	-0.07	0.12	0.04	0.00	0.02	0.00	-0.25	0.00	-0.25	-0.18	-0.02	-0.13	-0.18	0.03	-0.32	0.22	-0.30	1	
fcr	-0.11	-0.10	-0.07	-0.07	0.19	0.11	-0.02	0.03	-0.03	-0.25	0.03	-0.27	-0.26	-0.07	0.04	-0.22	0.05	-0.40	-0.33	-0.30	0.43	1
agr	0.15	0.05	-0.03	0.15	-0.24	-0.15	0.03	-0.02	0.04	0.31	-0.03	0.37	0.32	0.13	-0.09	0.28	-0.05	0.45	0.54	0.70	.48	-0.73
pap	-0.18	-0.08	-0.07	-0.02	0.22	0.13	-0.02	0.04	-0.04	-0.29	0.01	-0.33	-0.30	-0.10	0.08	-0.30	0.06	-0.44	-0.45	-0.33	0.49	0.7

	agr	pap
agr	1	
pap	-.80	1

Note:
chi: Children Ever Born
ste: Sterilization Rate
fst : Male Sterilization Rate
mst: Female Sterilization Rate
e1: Wife's Education
e2: Husband's Education
age1: Wife's Age
mag: Marital Period in Month
agr: Marital years over 14 years
rur: Living in Rural Area
thr: hree-Generation Familial Structure
fag: Wife's Agri. Occup.
hag: Husband's Agri. Occup.
pap: With One-child Paper before First Childbirth
nop: No One-child Paper
noi: Number of Birth without Quota
dea: Number of Dead Children
tfr: Total Fertility Rate
imr: Infant Mortality Rate
fop: Female Occupation Participation Rate
fdr: Female Divorce Rate
fcr: Female College Graduation Rate
agr: Agricultural Participation Rate
pap: One-Child Certificate Rate

Source: SFPCC 1989, and NBSC 1991

Table 6.2 Correlation Matrix of Individual and County Variables in Taiwan.

	chi	ste	fst	mst	e1	e2	mag	age	thr	fag	hag	dea	boy	gir	out	now	pia	tfr	imr	fop	fdr
chi	1																				
ste	0.38	1																			
fst	0.38	0.96	1																		
mst	0.03	0.20	-0.07	1																	
e1	-0.49	-0.27	-0.27	0.00	1																
e2	-0.42	-0.23	-0.24	0.01	0.71	1															
mag	0.65	0.33	0.31	0.09	-0.51	-0.38	1														
age	0.48	0.28	0.26	0.07	-0.32	-0.19	0.84	1													
thr	-0.04	-0.02	-0.01	-0.03	0.01	0.01	-0.17	-0.20	1												
fag	0.15	0.11	0.12	-0.01	-0.16	-0.12	0.14	0.10	0.03	1											
hag	0.18	0.11	0.12	-0.02	-0.18	-0.17	0.13	0.08	0.08	0.50	1										
dea	0.19	0.05	0.05	-0.01	-0.09	-0.08	0.09	0.06	-0.01	0.02	0.04	1									
boy	0.51	0.34	0.33	0.03	-0.33	-0.27	0.43	0.32	-0.02	0.10	0.12	0.13	1								
gir	0.67	0.13	0.13	0.00	-0.26	-0.23	0.35	0.26	-0.02	0.08	0.10	0.09	-0.30	1							
out	-0.20	-0.10	-0.11	0.03	0.24	0.26	-0.10	-0.04	-0.08	-0.07	-0.10	-0.03	-0.14	-0.11	1						
now	0.00	-0.01	-0.01	-0.01	0.01	0.00	-0.09	-0.07	-0.01	-0.10	0.00	-0.01	0.00	0.01	0.02	1					
pia	-0.03	-0.01	-0.02	0.03	0.24	0.26	0.05	0.11	-0.04	-0.05	-0.06	-0.02	-0.09	0.04	0.05	-0.01	1				
tfr	0.18	0.09	0.09	0.00	-0.20	-0.20	0.03	-0.07	0.16	0.13	0.19	0.06	0.12	0.10	-0.17	-0.05	-0.09	1			
imr	0.09	0.03	0.04	-0.01	-0.07	-0.06	0.01	-0.04	0.07	0.12	0.13	0.04	0.06	0.05	-0.06	0.00	-0.03	0.50	1		
fop	-0.08	-0.07	-0.08	0.02	0.12	0.12	-0.03	0.02	-0.04	-0.02	-0.04	-0.02	-0.06	-0.03	0.12	-0.02	0.03	-0.22	-0.02	1	
fdr	-0.15	-0.12	-0.12	0.00	0.17	0.17	-0.02	0.06	-0.16	-0.14	-0.20	-0.02	-0.10	-0.08	0.20	0.05	0.08	-0.67	-0.13	0.25	1
fcr	-0.18	-0.11	-0.11	0.01	0.26	0.24	-0.06	0.07	-0.12	-0.12	-0.16	-0.05	-0.12	-0.09	0.19	0.02	0.10	-0.81	-0.32	0.51	0.58
agr	0.17	0.12	0.13	-0.01	-0.20	-0.18	0.03	-0.08	0.17	0.20	0.26	0.04	0.12	0.08	-0.20	-0.04	-0.08	0.71	0.48	-0.26	-0.80

	fcr	agr
fcr	1	
agr	-0.69	1

Note:
chi: Children Ever Born
ste: Sterilization Rate
fst: Male Sterilization Rate
mst: Female Sterilization Rate
e1: Wife's Education
e2: Husband's Education
age1: Wife's Age
mag:Marital Period in Month
thr:Three-Generation Familial Structure
fag:Wife's Agricultural Occupation
hag:Husband's Agricultural Occupation
dea:Number of Dead Children
boy:Number of Boys
gir:Number of Girls
out:Mainlander Status
now:Nowork Status
pia:Whether owning Piano
fop:Female Occupation Participation Rate
fcr:Female College Graduation Rate
agr:Agricultural Participation Rate
tfr: Total Fertility Rate
imr: Infant Mortality Rate
fdr: Female Divorce Rate

Source: TAPIFP 1992, and EYRC 1992

Table 6.3 Robust Regression Models of Children Ever Born, Sterilization Rate and Female Sterilization Rate for 1990 China and 1991 Taiwan.

	China -Province Level-			Taiwan -County Level-		
	Children Ever Born	Couple Sterilization Rate	Wife Sterilization Rate	Children Ever Born	Couple Sterilization Rate	Wife Sterilization Rate
Female Occupation Participation Rate	0.45	-0.39	-0.93	-0.26	-0.01	0.01
o-year-old Mortality Rate	20.85	6.63	-0.61	0.0045	0.0031	0.0035 *
Total Fertility Rate	0.0002	-0.0001	-0.0001	0.0002	-0.0003	-0.0003 *
Female Divorce Rate	-49.58	-41.38	-4.98	-0.06	-0.03	-0.03 *
Female College Graduation Rate	41.34	-14.57	-3.60	-2.22	-1.31	-1.38 *
One-Child Certificate Rate	-10.27	2.40	-0.43			
cons	2.70 *	0.89	1.18 *	2.67 *	0.97 *	0.99 *
N	29	29	29	23	23	23

Note: ***** *p*<.05

Source: TPIFP 1992, EYRC 1992, SFPCC 1989 and NBSC 1991

In terms of the hypothetical relationship between predictors and CEB, 0-year-old Mortality Rate is expected to have a positive effect on CEB; that is, when a province has higher 0-year-old Mortality Rate, number of Children Ever Born will be higher. Female Divorce Rate and One-Child Certificate Rate conform to the hypotheses in Chapter V; that is, they have negative effects on CEB. When they are higher in a province, then a province has lower CEB. The significant effect of Female College Graduation Rate is, however, contrary to the hypothesis. The reversed 'U' pattern postulated by Jejeebhoy (1995) for the relationship between education and fertility gains some support in this macro-level analysis.

In Table 6.3, male sterilization data for China and Taiwan are not included because no predictor passes the significance test. Judging from Table 5.3 and Table 5.5, male sterilization rate is uniformly low, so it is not difficult to understand that the failure of all predictors to pass the significance test is due to lack of variance in the dependent variable. Regarding couple sterilization rate in the second column of Table 6.3, 0-year-old Mortality Rate, Total Fertility Rate, and Female Divorce Rate have significant effects. The variable of 0-year-old Mortality Rate shows a positive effect on the sterilization rate, which does not conform to the hypothesis in Chapter V that posits that if people perceive a high risk of being bereaved of children, they are more likely to seek security by producing more children and that consequently the sterilization rate should be low. However, it is not difficult to understand this empirical result. When a province has a higher 0-year-old Mortality Rate, the pace of its economic development may well be sluggish, so that alternatives to sterilization may not be available. As mentioned in Chapter IV, Short and her associates (2000) revealed that the risk of sterilization is highest in communities where the birth planning policy is least robust. As expected, the Total Fertility Rate is negatively related to couple sterilization status. Female Divorce Rate likewise shows a negative effect with couple sterilization status. The provinces with higher Female Divorce Rates, such as Shanghai (0.9%) and Beijing (0.7%) also have higher living standards and higher women's status, so it is understandable that women and men living in these provinces can find other alternatives for birth control. Only Female Occupation Participation Rate shows a significantly negative effect on female sterilization rate (in the third column of Table 6.3, wife sterilization status). This result accords with the hypothesis in Chapter V that when women live in provinces that have higher female employment rates, women's status should concomitantly be higher, so they tend to use sterilization less frequently as a measure to control childbirth.

In the 1992 Taiwan county-level data in the fourth column of Table 6.3, 0-year-old Mortality Rate, Female Divorce Rate, and Female College Graduation Rate pass the significance tests on the number of Children Ever Born. As in the data for China, 0-year-old Mortality Rate and Female Divorce Rate confirm the hypotheses. Unlike the results in China's data, however, the higher the Female College Graduation Rate is in counties, the lower the number of Children Ever Born. That result conforms with the hypothesis that when women achieve higher educational levels, they prefer to have fewer children.

In the fifth column of Table 6.3, the couple sterilization rate at the county level is significantly influenced by 0-year-old Mortality Rate, Total Fertility Rate, Female Divorce Rate, and Female College Graduation Rate. These predictors function the same way in China's data for the couple sterilization rate. Also, the higher Female College Graduation Rate is associated with a lower sterilization rate at the county level. In the sixth column of Table 6.3, female sterilization rate has the identical predictors and relationship direction as couple sterilization. This pattern diverges significantly from that seen regarding the female sterilization rate in China.

Individual-level Poisson Analysis

How well do the four Poisson regression models of children ever born improve our ability to predict the probabilities of a woman's having each count of children (that is, 0 children, 1 child, 2 children, etc. up to 15 children, in the 1988 China data; or up to 9 children in the 1992 Taiwan data). Based on the independent variables, every woman will have a predicted probability of having 0 children, a probability of having 1 child, a probability of having two children, etc., up to a probability of having 9 or 15 children; these probabilities will be based on the knowledge of each woman's values on the 8 independent variables for two models of Taiwan and the 10 independent variables for the two models of China (refer to Table 6.3 and 6.4).

These predicted probabilities can be compared with the observed empirical distribution of children at each count; likewise, the probabilities predicted by the Poisson model can be compared the probabilities shown by the univariate Poisson distribution with a mean of 2.71 for China and 2.48 for Taiwan (refer to Figure 5.3).

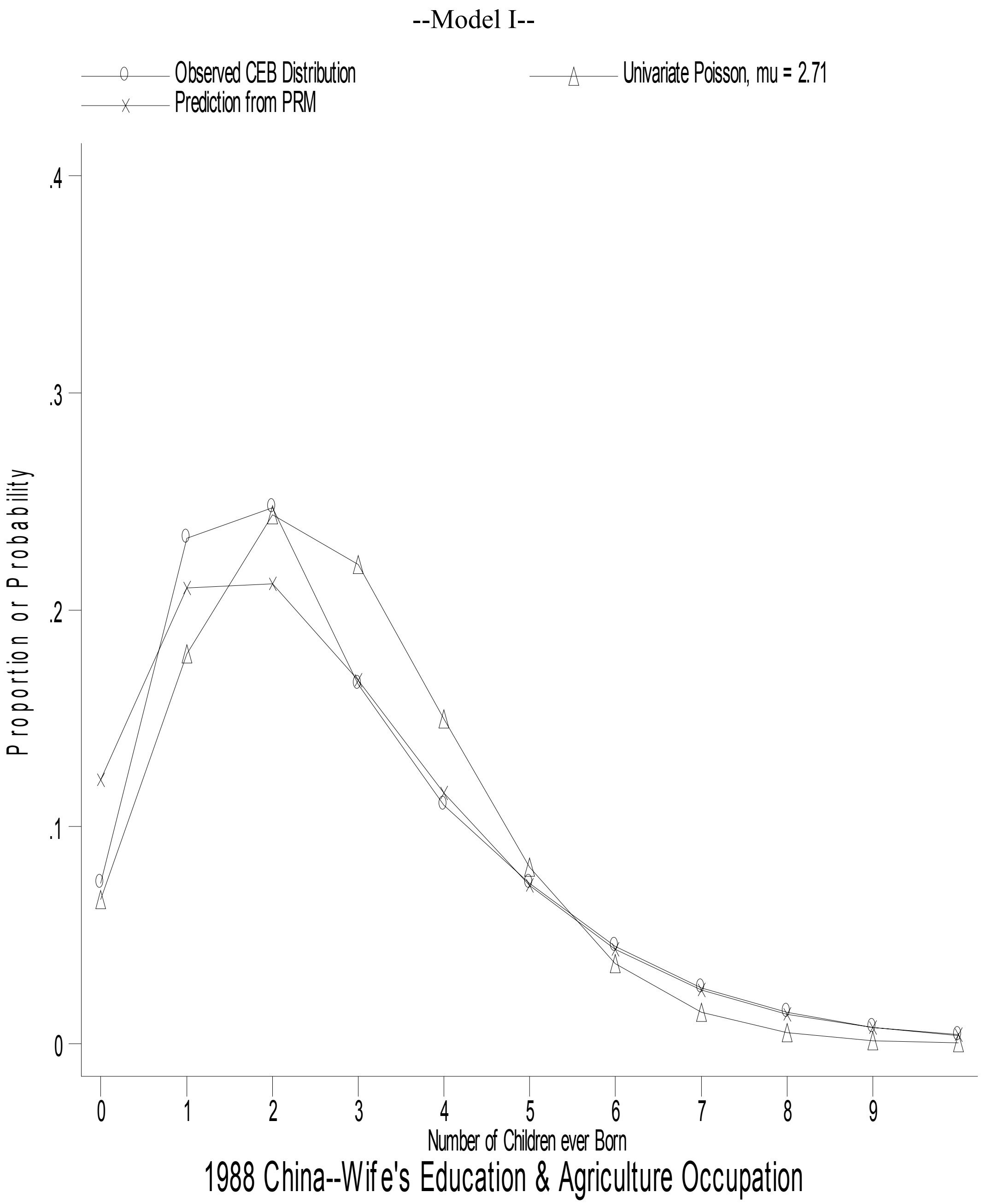
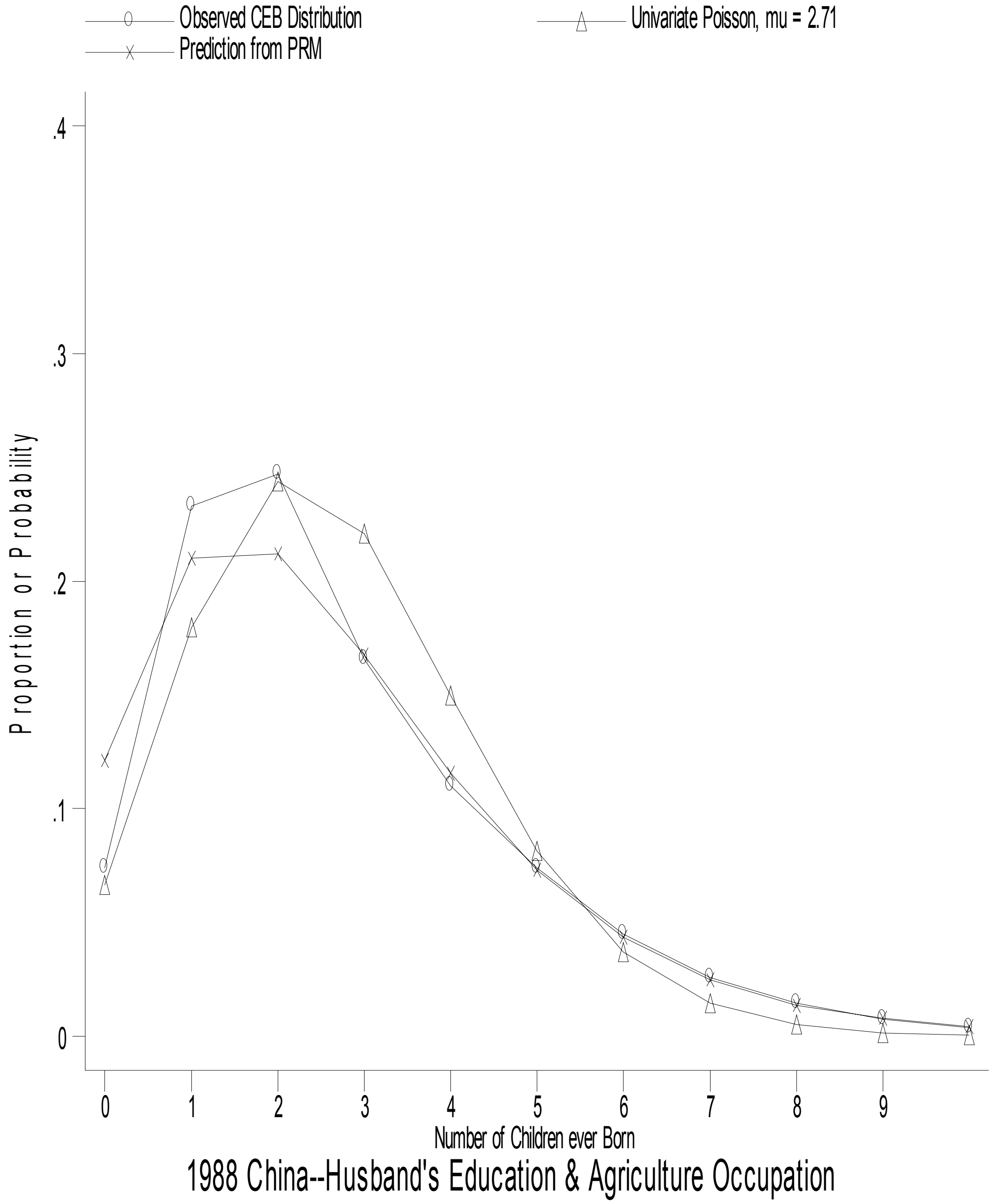


Figure 6.1 Distributions of CEB, Univariate Poisson, and Poisson Regression Model for 1988 China Data

--Model II--



Source: SFPCC 1989 and NBSC 1991

Figure 6.1 (Continued)

--Model I--

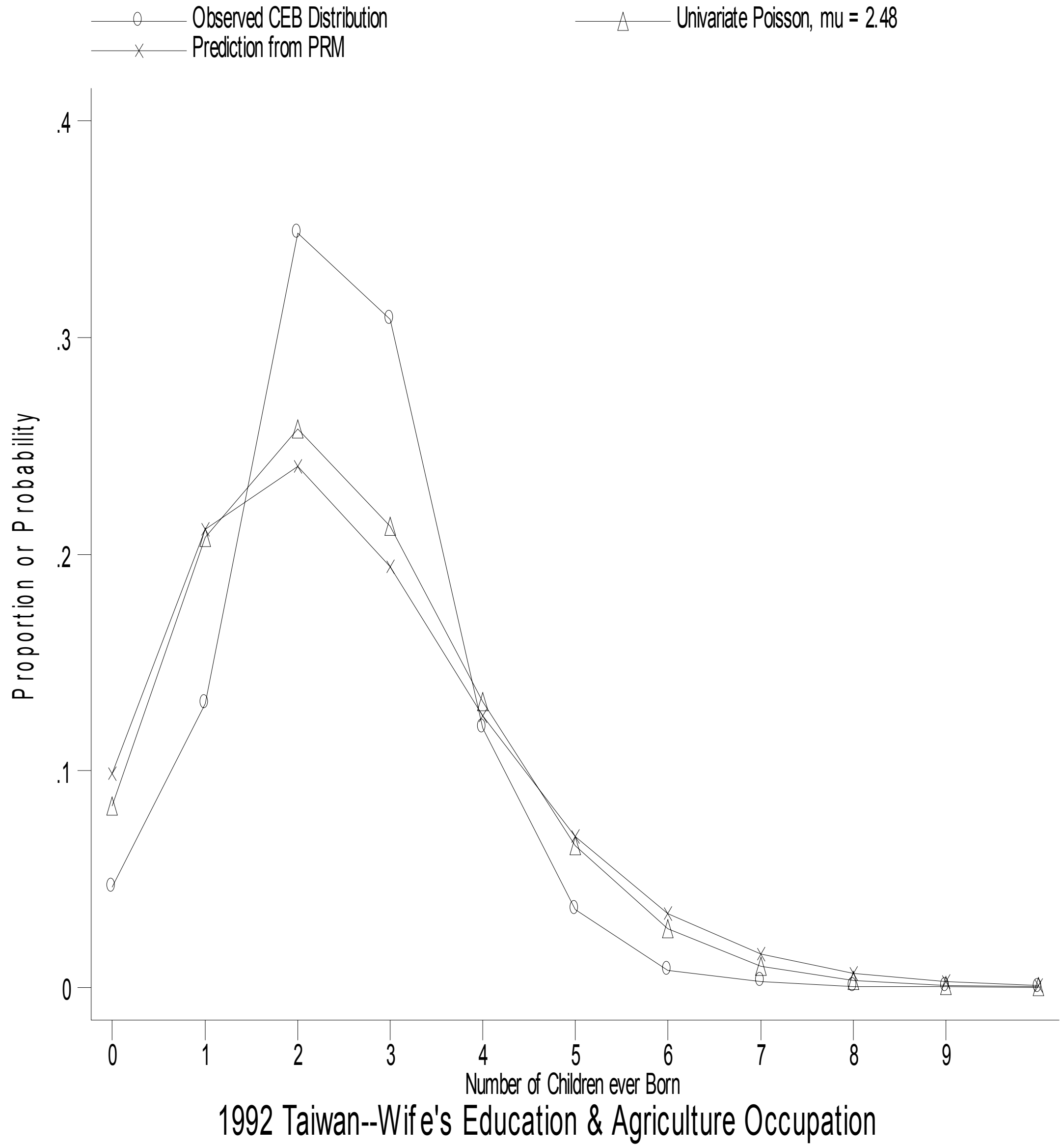
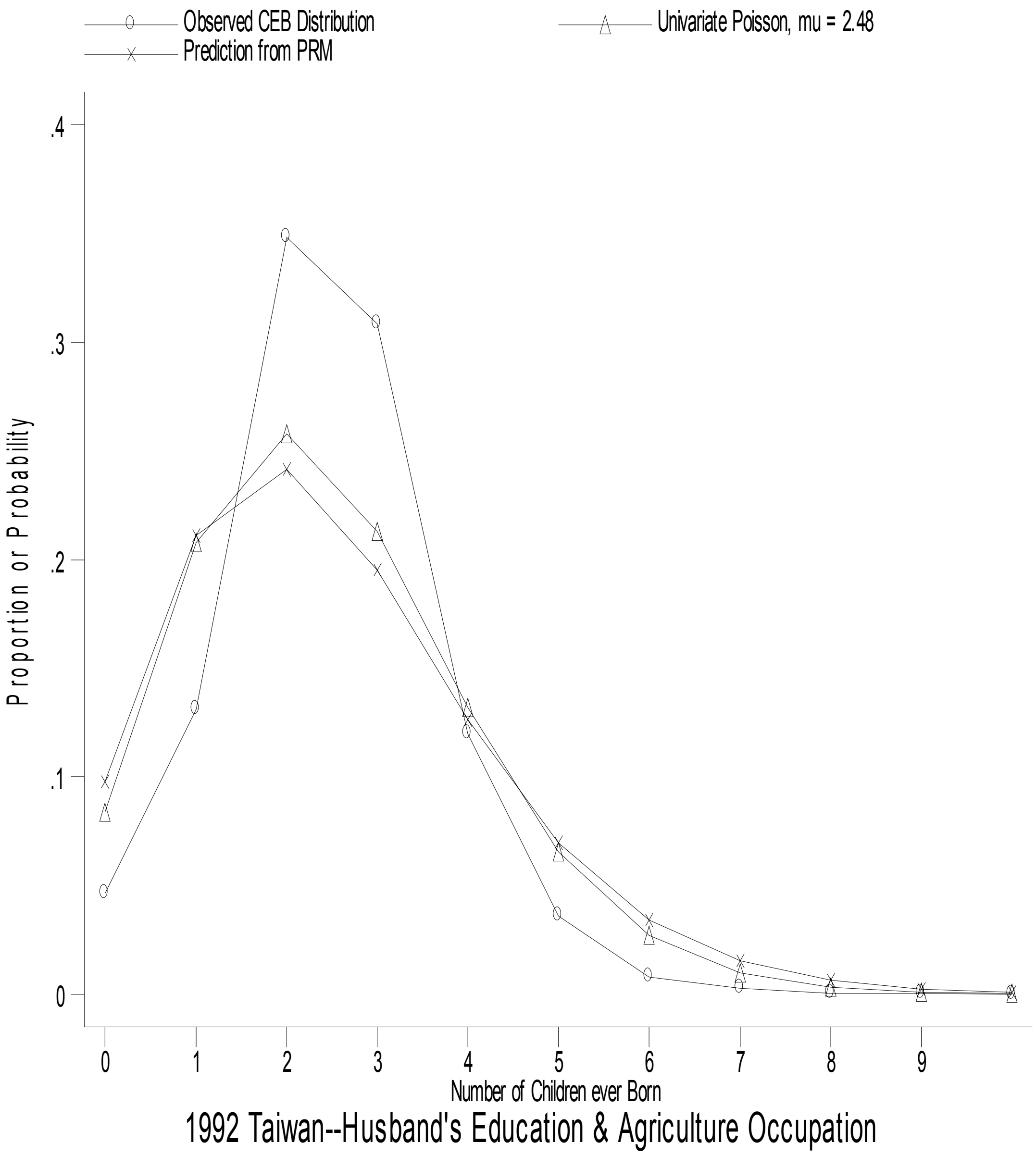


Figure 6.2 Distributions of CEB, Univariate Poisson, and Poisson Regression Model for 1992 Taiwan Data

--Model II--



Source: TPIFP 1992, and EYRC 1992

Figure 6.2 (Continued)

To summarize the predictions of the Poisson regression model, the mean predicted probability for each count, ***m***, can be used:

$$\overline{\Pr}(y = m) = \frac{1}{N}\sum_{i=1}^{N} \frac{\exp(-\hat{\mu}_i)\,\hat{\mu}_i^{m}}{m!}$$

where $-\hat{\mu}_i$ is the number of predicted CEB based on the Poisson regression model for each of the *i*th Chinese or Taiwanese women in the samples. Figures 6.1 and 6.2 are the Distributions of CEB, Univariate Poisson, and Poisson Regression Model for China and Taiwan.

Also, in Table 6.4 and Table 6.5, I examine the formal “goodness of fit” test presented in the last two rows, comparing the observed empirical distribution with the distribution predicted by the Poisson regression model. The null hypothesis (H0) is that there is no difference between the observed data and the modeled data, indicating that the model fits the data.

A small value of chi-square is expected, with a probability > 0.05. If there is a small chi-square, it indicates that the model fits the data. Although the values for the goodness of fit tests in Table 6.4 and Table 6.5 are not perfect, they are satisfactory for my models. They signify that the models fit the data very well; specifically, the goodness of fit χ2 test indicates that, given the Poisson regression models, I cannot reject the null hypothesis that the observed data are Poisson distributed.

Table 6.4 Poisson Regression Models Predicting Number of Children Ever Born for 1988 China Data.

	Model I (Wife's Education and Agricultural Occupation)								Model II (Husband's Education and Agricultural Occupation)							
	b		min->max	0->1 0->1	IRR(e^b)	%	e^bStdX	%StdX %StdX	b		min- >max	0->1 0->1	IRR(e^b)	%	e^bStdX	%StdX
Number of Dead Children	0.23	*	15.47	0.58	1.26	25.7	1.16	16.4	0.23	*	15.19	0.58	1.25	25.4	1.16	16.3
Han Status	-0.08	*	-0.20	-0.20	0.92	-7.7	0.98	-2.4	-0.08	*	-0.19	-0.19	0.93	-7.4	0.98	-2.3
Three-Generation Familial Structure	-0.38		-0.77	-0.77	0.69	-31.2	0.90	-9.6	-0.37		-0.77	-0.77	0.69	-31.1	0.90	-9.5
No One-child Certificate	0.33	*	0.71	0.71	1.39	39.1	1.13	12.8	0.33	*	0.71	0.71	1.39	39.3	1.13	12.9
Experience of Childbirth with Quota	-0.31	*	-0.71	-0.71	0.73	-26.6	0.86	-13.7	-0.31	*	-0.71	-0.71	0.73	-26.7	0.86	-13.7
Wife's Education	-0.01	*	-0.34	-0.03	0.99	-1.0	0.96	-4.0								
Husband's Education									-0.01	*	-0.27	-0.02	0.99	-0.8	0.97	-2.8
Wife's Age	0.02	*	1.87	0.02	1.02	1.8	1.19	19.1	0.02	*	1.93	0.02	1.02	1.8	1.20	19.8
Married More than 14 years	0.11	*	0.27	0.27	1.12	11.9	1.06	5.8	0.12	*	0.28	0.28	1.12	12.2	1.06	5.9
Wife's Agricultural Occupation	0.04	*	0.08	0.08	1.04	3.6	1.02	1.5								
Husband's Agricultural Occupation									0.07	*	0.15	0.15	1.07	6.7	1.03	3.1
Living in Rural Area	0.05	*	0.11	0.11	1.05	4.6	1.02	1.8	0.04	*	0.10	0.10	1.04	4.5	1.02	1.7
constant	0.05								0.01							
Goodness-of-fit chi2	22623.50								22591.71							
Prob > chi2	1.0000 (30002 cases)								1.0000 (30002 cases)							

Note:

b = raw coefficient   Min->Max: change in predicted probability as x changes from its minimum to its maximum

0->1: change in predicted probability as x changes from 0 to 1

IRR (e^b)--Incidence Rate Ratios = exp(b) = factor change in expected count for unit increase in X

%--The Percent Change in Poisson Incidence Rate Ratios = percent change in expected count for unit increase in X

e^bStdX--Incidence Rate Ratios Standardized on the X Variable = exp(b*SD of X) = change in expected count for SD increase in X

Source: SFPCC 1989 and NBSC 1991

Table 6.5 Poisson Regression Models Predicting Number of Children Ever Born for 1992 Taiwan Data.

	Model I (Wife's Education and Agricultural Occupation)								Model II (Husband's Education Agricultural Occupation)							
	b		min->max	0->1	IRR(e^b)	%	e^bStdX	%StdX	b		min->max	0->1	IRR(e^b)	%	e^bStdX	%StdX
Number of Dead Children	0.18	*	4.58	0.47	1.19	19.4	1.04	4.4	0.18	*	4.674	0.48	1.20	19.6	1.04	4.4
Three-Generation Familial Structure	0.03	*	0.08	0.08	1.03	3.1	1.01	1.5	0.04	*	0.085	0.09	1.04	3.5	1.02	1.7
Nowork Status	0.05	*	0.12	0.12	1.05	4.9	1.02	2.2	0.04	*	0.106	0.11	1.04	4.4	1.02	2.0
Mainlander Status	-0.14	*	-0.33	-0.33	0.87	-13.3	0.95	-4.8	-0.14	*	-0.334	-0.33	0.87	-13.4	0.95	-4.9
Whether owning Piano	0.03		0.08	0.08	1.03	3.3	1.01	1.1	0.02		0.036	0.04	1.01	1.5	1.00	0.5
Wife's Education	-0.04	*	-1.70	-0.13	0.96	-3.9	0.87	-13.5								
Husband's Education									-0.03	*	-1.466	-0.11	0.97	-3.3	0.89	-11.1
Wife's Age	0.03	*	1.64	0.03	1.03	2.9	1.18	18.0	0.03	*	1.879	0.03	1.03	3.3	1.21	20.9
Wife's Agricultural Occupation	0.11	*	0.28	0.28	1.11	11.5	1.02	2.0								
Husband's Agricultural Occupation									0.13	*	0.323	0.32	1.13	13.4	1.03	3.2
constant	0.25	*							0.088							
Goodness-of-fit chi2	4220.18								4327.80							
Prob > chi2	1.0000 (11247 cases)								1.0000 (11244 cases)							

Note:

b = raw coefficient

Min->Max: change in predicted probability as x changes from its minimum to its maximum

0->1: change in predicted probability as x changes from 0 to 1

IRR (e^b)--Incidence Rate Ratios = exp(b) = factor change in expected count for unit increase in X

%--The Percent Change in Poisson Incidence Rate Ratios = percent change in expected count for unit increase in X

e^bStdX--Incidence Rate Ratios Standardized on the X Variable = exp(b*SD of X) = change in expected count for SD increase in X

%StdX--Percent Change in Poisson Incidence Rate Ratios Standardized on the X Variable = percent change in expected count for SD increase in X

Source: TPIFP 1992, and EYRC 1992

Several indicators show the effects of the predictors on CEB. In Table 6.4, the raw coefficient is in the first column. Each predictor in the Model I and Model II is statistically significant. In terms of the hypotheses proposed in Chapter V, each predictor, with the sole exception of Three-Generation Familial Structure, matches the original expectation. Because the predicted number of children ever born for each woman is nonlinearly related to the independent variables, the cumulative change in the expected number of children ever born to each woman must be investigated independently for each dependent variable. For a dummy independent variable, the distinct changes can be interpreted by looking at the 0->1 column (the third and tenth columns of Table 6.4). For the rural variable, the number of children ever born increases to 0.11 as the rural dummy changes from 0 to 1 (rural). Holding the other independent variables at their means, rural women have 0.11 more children than non-rural women. For the variable of Wife's Agricultural Occupation, an increase of .08 children ever born is seen as the dummy changes from 0 to 1 (Wife's Agricultural Occupation). Women with Agricultural Occupation, therefore, have 0.08 more children than non-farming women, holding the other independent variables at their means. Husbands with Agricultural Occupation have 0.15 more children than non-farming husband, holding the other independent variables at their means. Those married more than 14 years have 0.27 more children than those not, holding the other independent variables at their means.

For interval variables, I examine the amount of change in the dependent variable as the independent variable goes from its minimum to maximum values; this statistic appears in the min->max column (the second and ninth columns of Table 6.4). So, the wife's education variable ranges from the minimum of 0 to the maximum of 14 years; over this 14 years of education, there is an average total reduction in CEB of 0.34 children, holding the other independent variables at their means. For husband's education, the range is also from the minimum of 0 to the maximum of 14 years, with an average total reduction in CEB of 0.27 children.

Long (1997, p. 228) has noted, "the simplest way to interpret the results" of the Poisson Regression coefficient is "by using the factor changes in the expected count." The Poisson Incidence Rate Ratios (IRR) coefficients in the fourth and eleventh columns of Table 6.4 are interpreted just like odds ratios. The IRR for Han status is $0.92 = e^{-.08}$. Being a Han woman, therefore, multiplies the expected number of children by a factor of 0.92, holding the other independent variables constant. Another way to express this statistic is to say that the number of children ever born to a Han woman is 8 percent ($=100\ (e^{-.08}-1)$) less than the CEB of a non-Han woman.

The Percent Change in Poisson Incidence Rate Ratios in the fifth and twelfth columns of Table 6.4 shows that for every additional child death for the independent variable of Number of Dead Children, a Chinese woman's mean production of children increases by 25.7%, holding all other variables constant. Women without a one-child certificate have 39.1% more children, holding all other variables constant.

In the sixth and thirteenth columns of Table 6.4 are Poisson Incidence Rate Ratios (standardized on the independent variable). The Poisson effects can be interpreted in a standardized way, by calculating IRR coefficients standardized on the independent variable. This is done by exponentiating the Poisson *b* coefficient after it has been multiplied by its standard deviation. For each standard deviation increase in the wife's age, a woman's mean CEB production is multiplied by a factor of 1.19, holding all other variables constant.

Concerning the seventh and twelfth columns of Table 6.4, Percent Change in Poisson Incidence Rate Ratios Standardized on the Independent Variable, several observations are in order. Regarding the effect of wife's age, for each standard deviation increase in the woman's age, her mean production of children increases by 19.1%, holding all other variables constant. Although it is illogical to interpret dummy variables (such as "rural" or "Han") in terms of coefficients that have been standardized on the independent variable, such standardized coefficients are useful to gauge the relative impacts on CEB of all of the independent variables. Therefore, from Table 6.4, in terms of absolute impacts on fertility behavior (positive or negative), the woman's age has the greatest impact, followed number of dead children, followed by the two policy variables: Experience of Childbirth with Quota, No One-child Certificate

In Table 6.5, the first column, the raw coefficient is shown. Most predictors in Model I and Model II are statistically significant. Owning a piano, however, is not. All of them are in agreement with the hypotheses proposed in Chapter V. For a dummy independent variable, the distinct changes can be observed by looking at the 0->1 column, the third and tenth columns of Table 6.5. For the Nowork variable, we observe an increase of 0.12 in the number of children ever born as the Nowork dummy changes from 0 to 1 (no work). Taiwanese women who do not have any work outside the home have 0.12 more children than non-rural women, holding the other independent variables at their means. For the variable of Wife's Agricultural Occupation, an increase is shown of 0.08 children ever born, as the dummy changes from 0 to 1 (Wife's Agricultural Occupation). Women with Agricultural Occupations have 0.28 more children than non-farming women, holding the other independent variables at their means. Husbands with Agricultural Occupations have 0.32 more children than non-farming husbands, holding the other independent variables at their means. Women who live in three-generation familial structure have 0.08 more children than those who do not, holding the other independent variables at their means.

For interval variables, the min->max columns (the second and ninth columns of Table 6.5) are examined. The wife's education variable ranges from the minimum of 0 to the maximum of 17 years; over this 17 years of education, there is an average total reduction in CEB of 1.70 children, holding the other independent variables at their means. For husband's education, the range is also from the minimum of 0 to the maximum of 17 years, with an average total reduction in CEB of 1.47 children.

The Poisson Incidence Rate Ratios (IRR) coefficients in the fourth and eleventh columns of Table 6.5 show Incidence Rate Ratios for Mainlander status of $0.87 = e^{-.14}$. Therefore, being a Mainlander woman multiplies the expected number of children by a factor of 0.87, holding the other independent variables constant. Expressing the statistic in another way, the number of children ever born to a Mainlander woman is 13 percent $(=100\ (e^{-.14}-1))$ less than the CEB of a non-Mainlander woman.

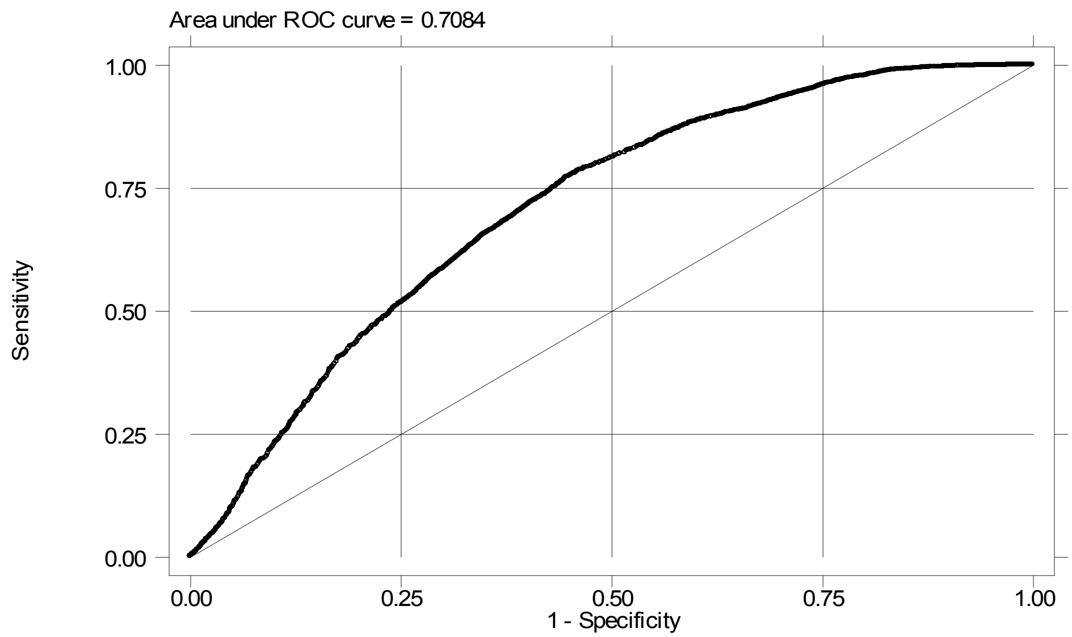
The Percent Change in Poisson Incidence Rate Ratios, in the fifth and twelfth columns of Table 6.5, shows that for every additional child death indexed by the independent variable of Number of Dead Children, a Taiwanese woman's mean production of children increases by 19.4%, holding all other variables constant. In the sixth and thirteenth columns of Table 6.5 are Poisson Incidence Rate Ratios standardized on the independent Variable. For each standard deviation increase in the wife's age, a woman's mean CEB production is multiplied by a factor of 1.18, holding all other variables constant.

Concerning Percent Change in Poisson Incidence Rate Ratios Standardized on the independent variable, in the twelfth columns of Table 6.5, when the wife's age increases by one standard deviation, her mean production of children augments by 18.0%, holding all other variables constant. Judging from Table 6.5 for absolute impacts on fertility behavior (positive or negative), the woman's age has the greatest impact (as was true with the data from China), followed by women's education or husband's education, followed by Mainlander status. This pattern is different from that seen in China's data.

Logistic Analysis

The micro-level logistic regression results are displayed in Tables 6.6 and 6.7 for China and Taiwan, respectively. To test the null hypothesis that all the X variables' coefficients are zero (this is similar to the global F-test in OLS regression), the "likelihood ratio chi-square" statistic, also called LR chi-square ($\boldsymbol{LR\chi^2}$), is examined; its values are shown in third line from the bottom of Table 6.6 and 6.7. The probability of a greater value of $\boldsymbol{LR\chi^2}$ is P = 0.000; the null hypothesis is thus rejected that the coefficients on the three independent variables are all zero. The bottom row of each table shows the values of **Pseudo R^2**, which does not have the "explained variance" interpretation of the **R^2** in OLS, but indicates how well the model fits the data. In addition, **ROC** (Receiver Operating Characteristics) curves in Figure 6.3 and Figure 6.4, function in a similar way. A model with no predictive power would be a 45° line. The greater the predictive power of the model, the more bowed the curve, so that the area beneath the curve is often used as a graphic measure of the model's predictive power. A model with no predictive power has an area of 0.5; a perfect model has an area of 1.0. The areas under the ROC curves in Figure 6.3 and 6.4 range from 0.76 to 0.66. on average, the 1992 Taiwan data produce bigger ROC areas than do the 1988 China data. In the couple sterilization status columns of Table 6.6, except for rural status for Model I, all predictors have passed statistical the significance test; that is, P-values are less than 0.05. In addition, the same predictors for Model I and Model II have similar statistical results. Both of the main variables reflecting women's statuses--education and agriculture status--have different effects on sterilization status. For each additional year of women's formal education, other things being equal, the odds of being sterilized are multiplied by 0.99 of the odds ratio; that is, they decrease by 1%. Other things being equal, for women working in an agricultural occupation, the odds of being sterilized are 26% higher than for those not. Those results agree with the hypotheses in Chapter V. More highly educated women know more options to control their fertility. Farming women are more inclined to end their reproduction by sterilization. However, the husband's education and agricultural occupation status both have positive effects on

Sterilization: Model I



Sterilization: Model II

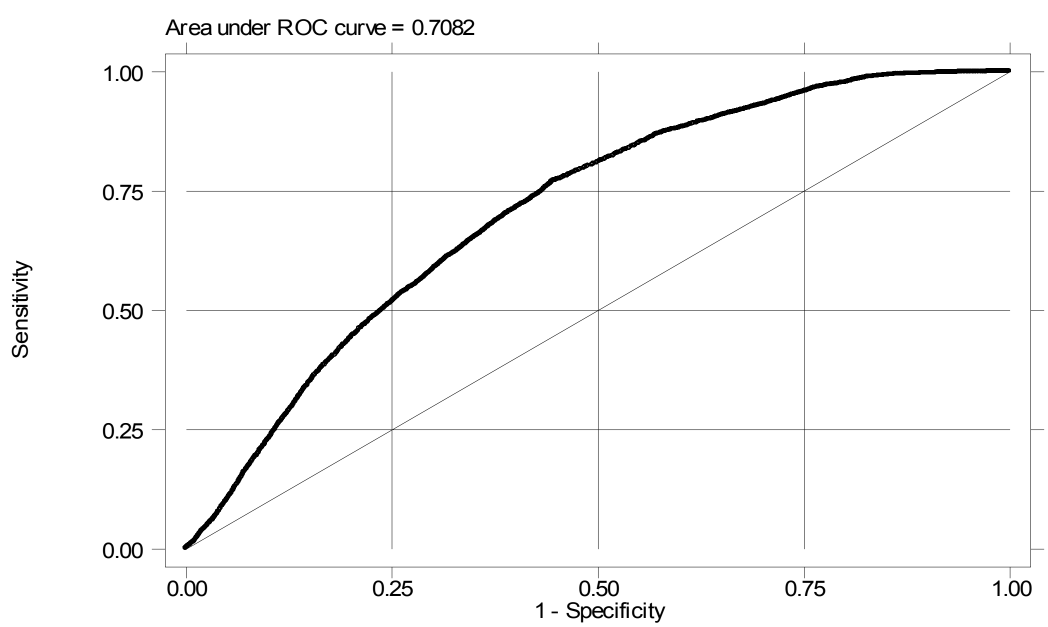
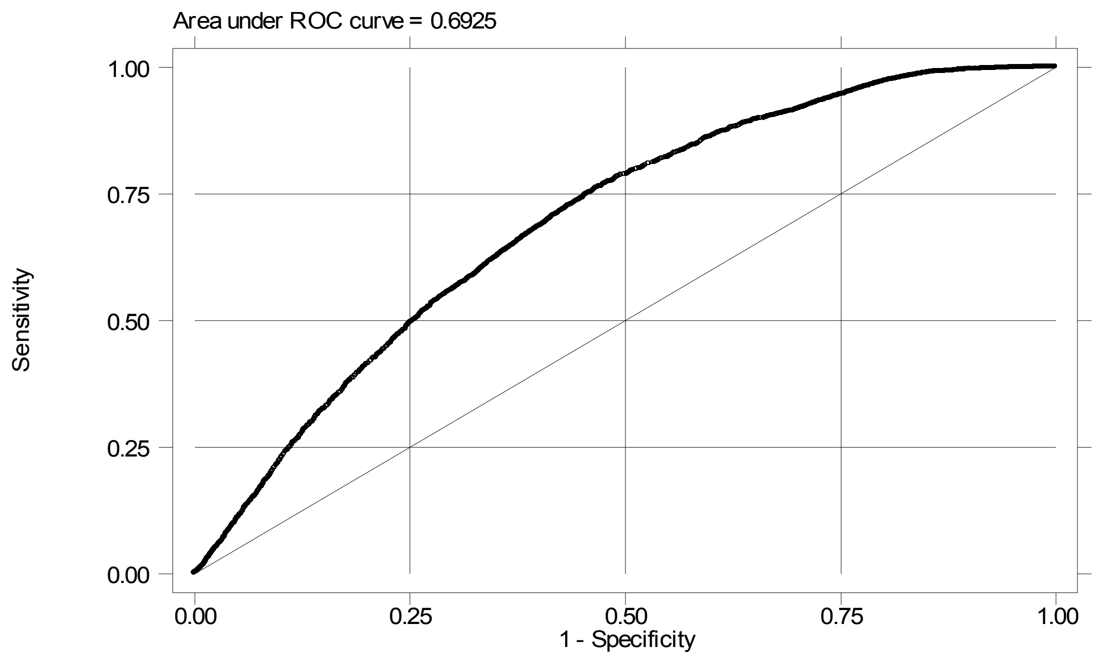


Figure 6.3 Receiver Operating Characteristics Curve for 1988 China Data

Female Sterilization: Model I



Female Sterilization: Model II

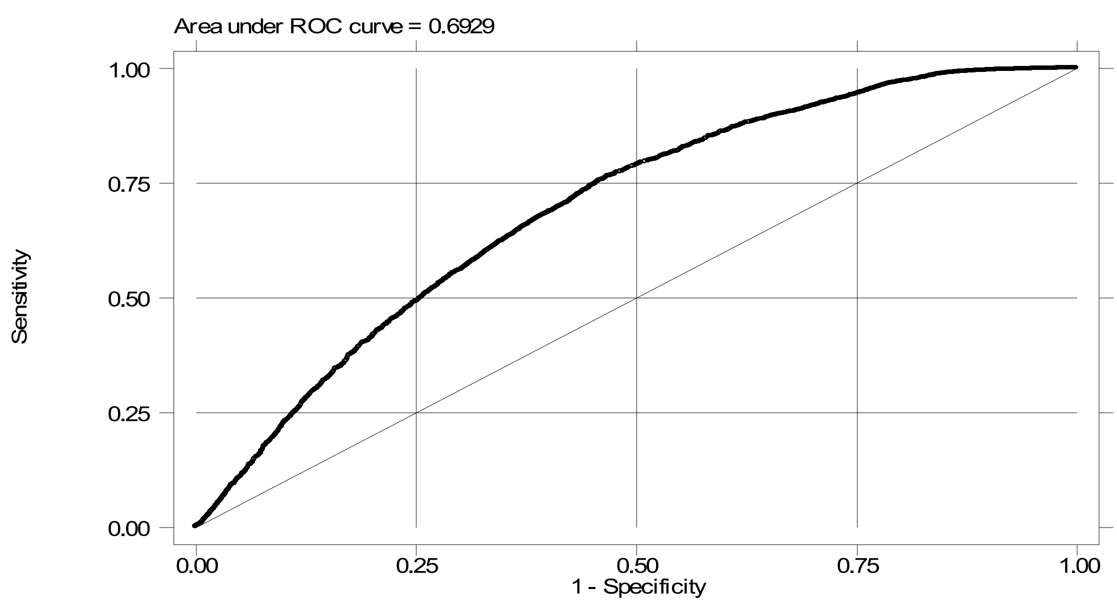
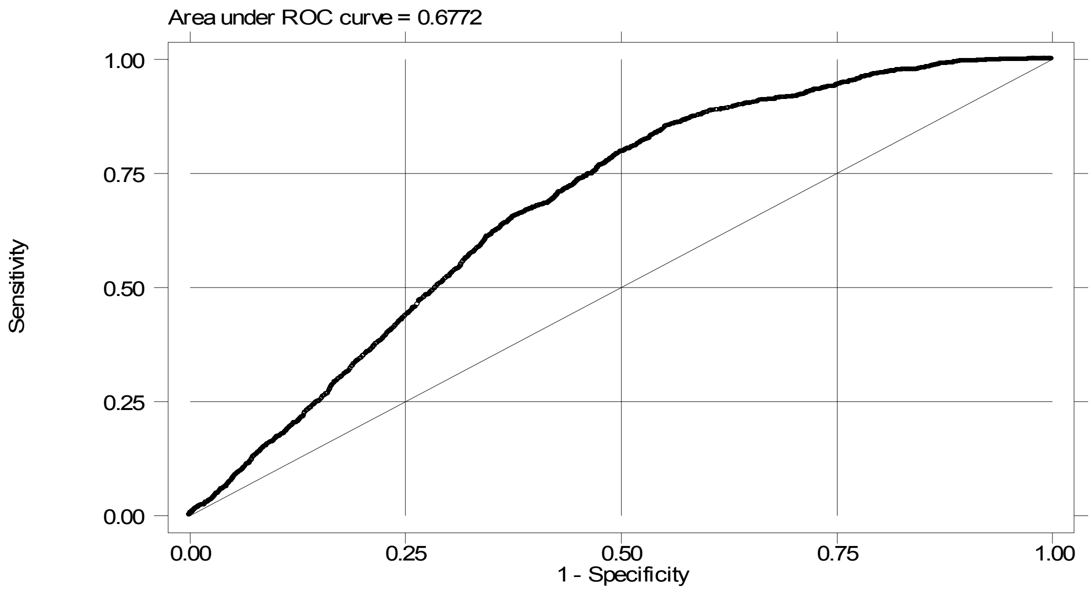
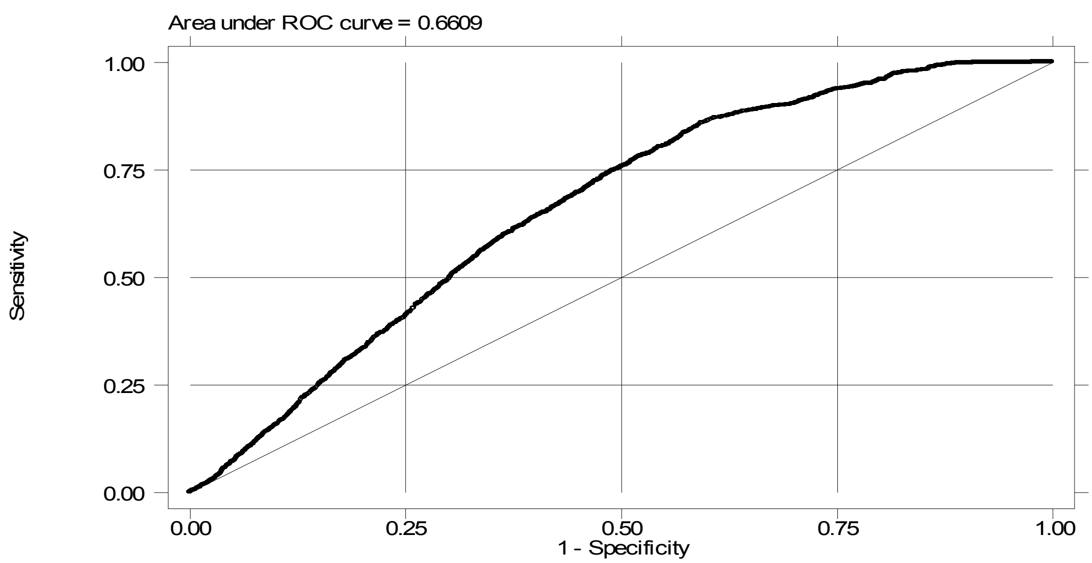


Figure 6.3 (Continued)

Male Sterilization: Model I



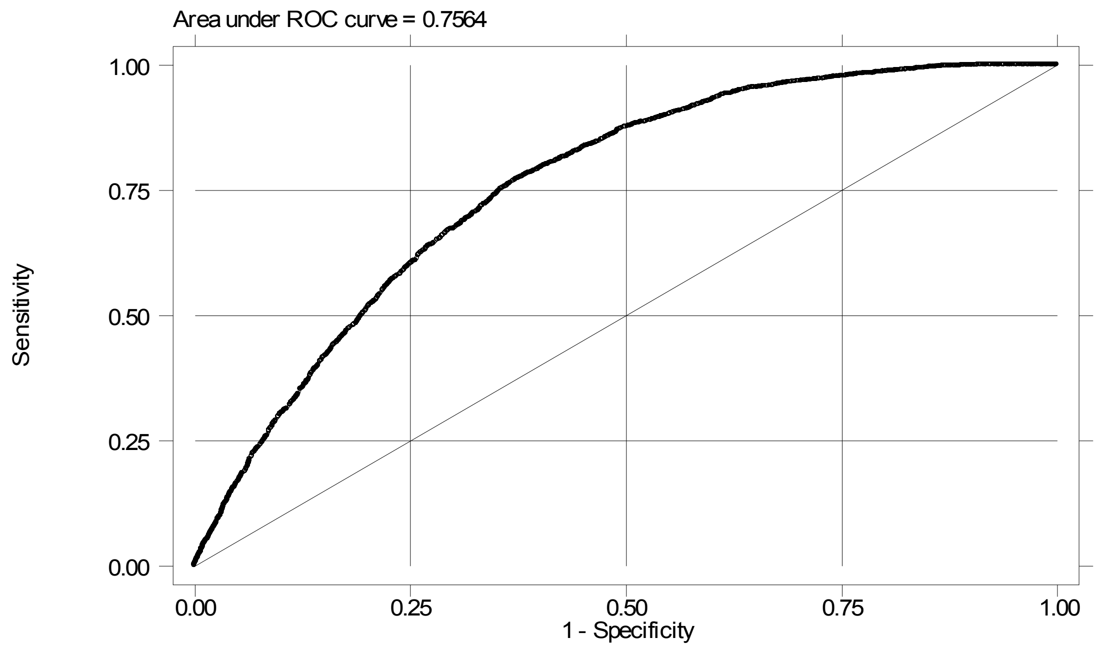
Male Sterilization: Model II



Source: SFPCC 1989 and NBSC 1991

Figure 6.3 (Continued)

Sterilization: Model I



Sterilization: Model II

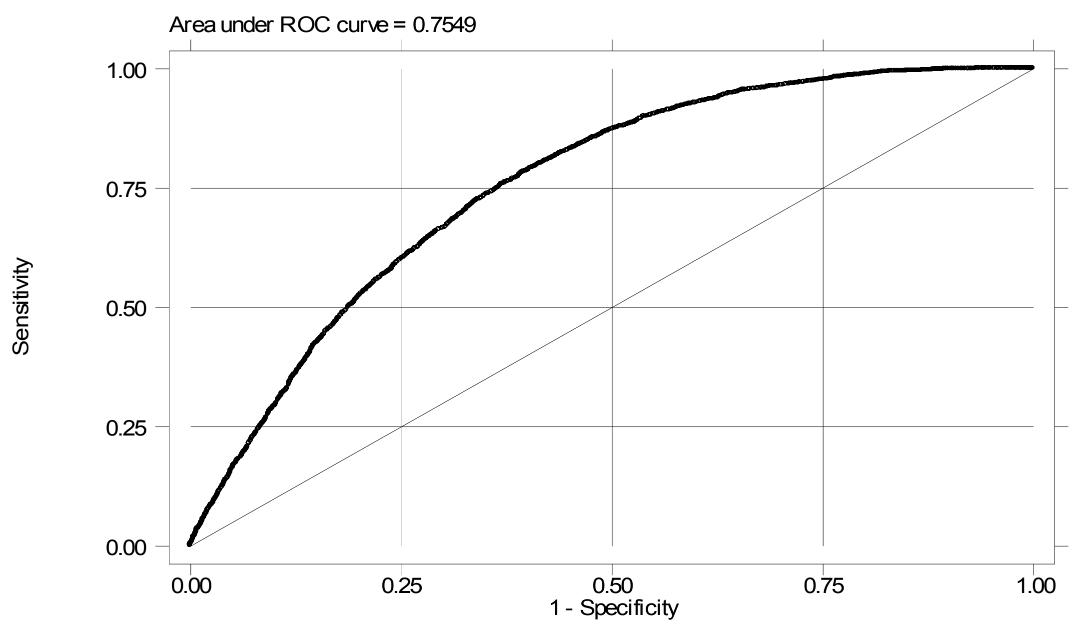
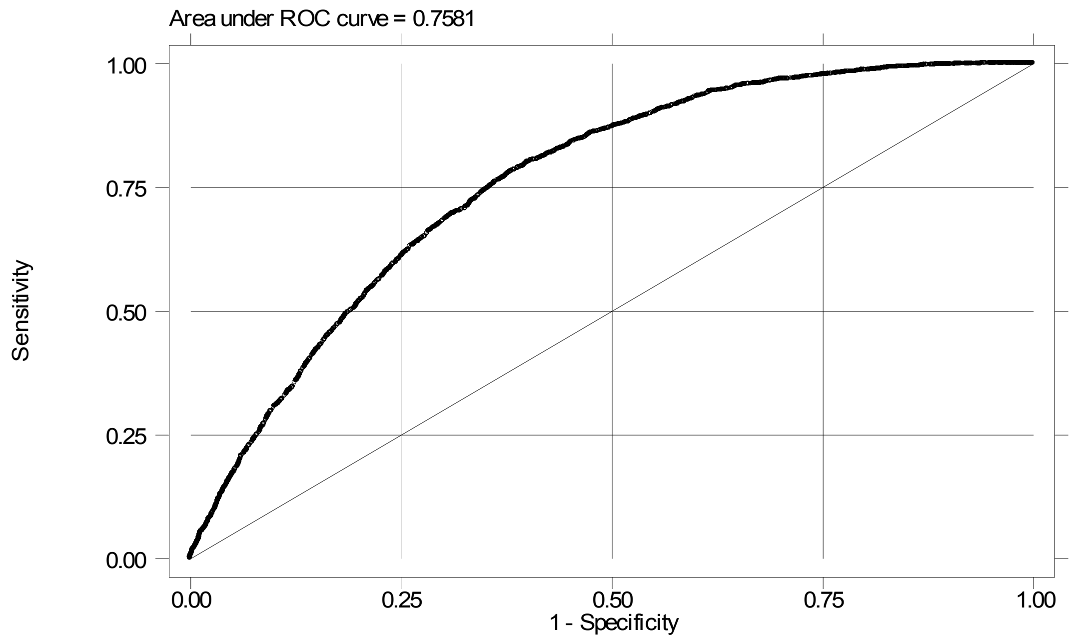


Figure 6.4 Receiver Operating Characteristics Curve for 1992 Taiwan Data

Female Sterilization: Model I



Female Sterilization: Model II

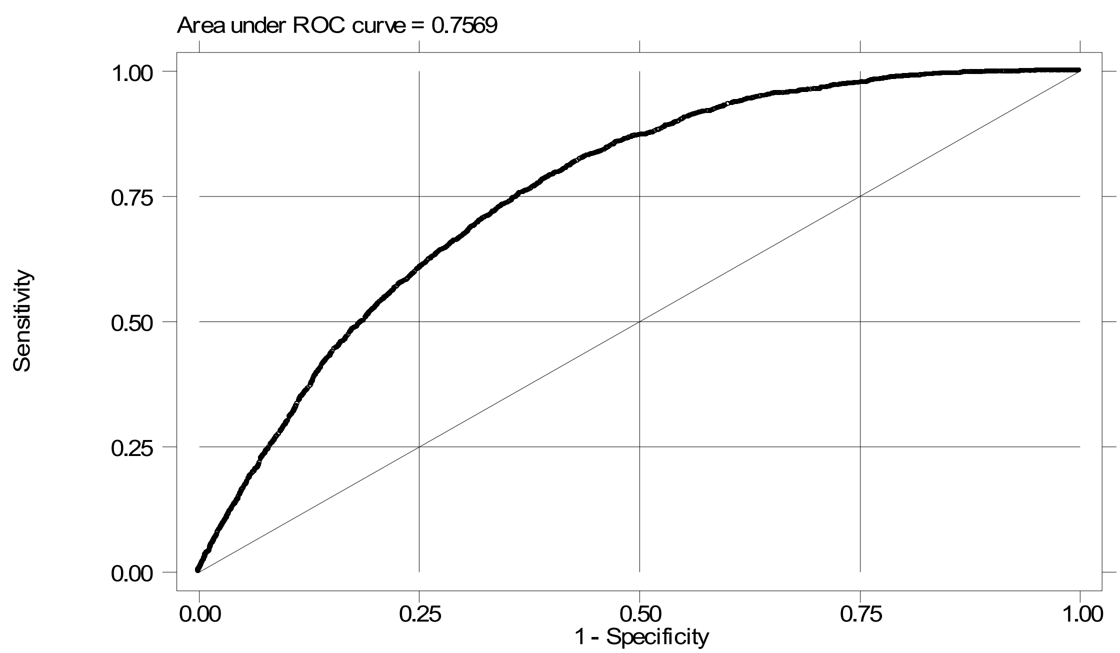
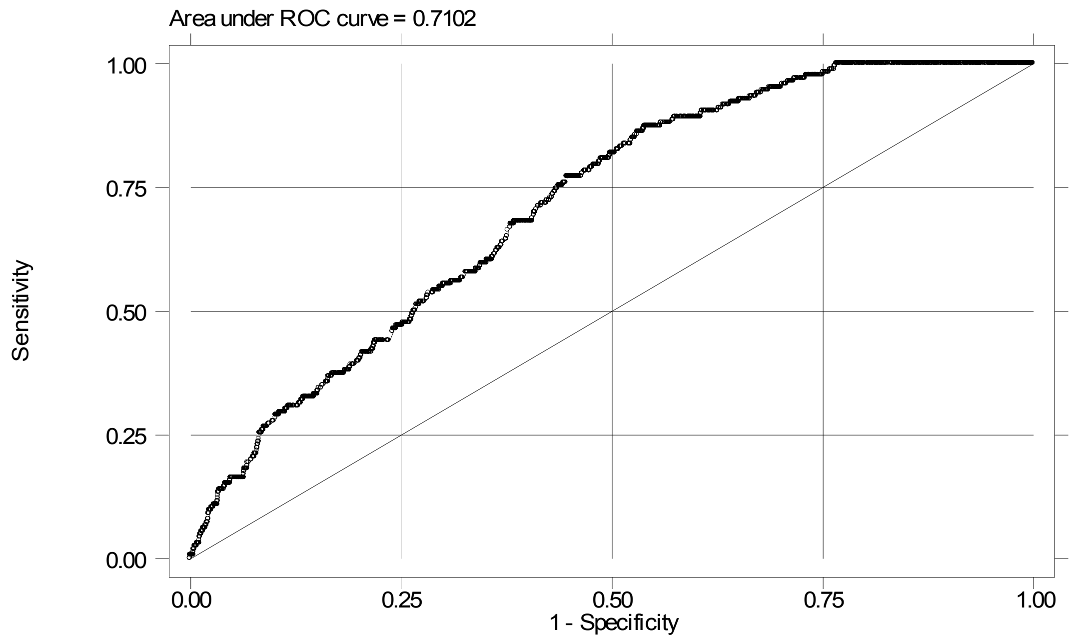
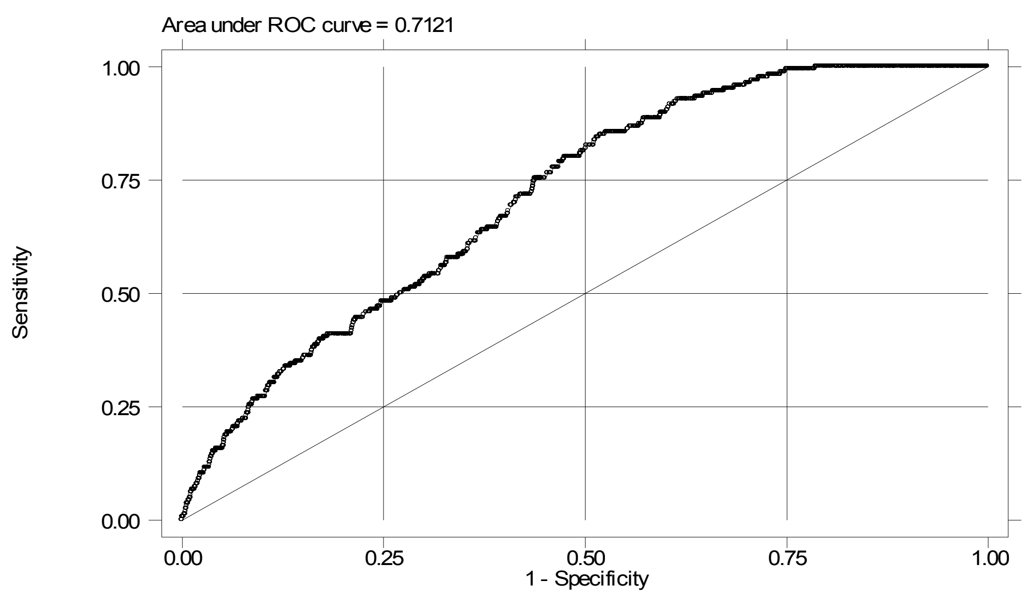


Figure 6.4 (Continued)

Male Sterilization: Model I



Male Sterilization: Model II



Source: TPIFP 1992, and EYRC 1992

Figure 6.4 (Continued)

overall sterilization for the marital couples in China. The logit coefficient for the husband's agricultural occupation variable is 0.16; its odds ratio,**Ω**, is $\mathbf{e^{0.16}}$, or 1.17.

This means that, other things being equal, the odds of being sterilized are 1.2 times higher for farming husbands than for non-farming husbands. Or one could say that being farming husbands increases the odds of being sterilized by 17%. In terms of husband's education, it means that for every additional year of schooling, other things being equal, the odds of being sterilized are multiplied by 1.01; that is, the odds increase by 1%.

Comparing these semi-standardized coefficients across independent variables reveals the relative strength or importance of each X variable's effect on Y, which in the case of logistic regression is the *ln odds*(Y=1). The value may be interpreted as the amount of change in the *ln odds*(Y=1) associated with a one standard deviation difference in the X variable. The experience of childbirth with quota, owning one-child certificates, and the number of boys show the three most important effects on sterilization status. The first two can be called policy influence. Couples with the experience of the childbirth quota have a 64% lower probability of sterilization than those without that experience. This result makes sense when we understand that couples fortunate enough to have a record of good compliance with the quota systems set up by their local cadres likely live in areas that furnish more extensive facilities and services to control fertility. So the couples can be programmed to the local quota system. In such cases, the probability of sterilization as a last resort to control fertility should be less than those in areas less adequately served. A converse rationale can be applied for the couples

Table 6.6 Micro-level Logistic Regression Models Predicting Three Sterilization Status for 1988 China Data.

	Couple Sterilization Status						Wife Sterilization Status						Husband Sterilization Status					
	Model I (Wife's Education and Wife's Agricultural Occupation)			Model II (Husband's Education and Husband's Agricultural Occupation)			Model I (Wife's Education and Wife's Agricultural Occupation)			Model II (Husband's Education and Husband's Agricultural Occupation)			Model I (Wife's Education and Wife's Agricultural Occupation)			Model II (Husband's Education and Husband's Agricultural Occupation)		
	b	Odds Ratio	bStdX▲	b	Odds Ratio	bStdX	b	Odds Ratio	bStdX	b	Odds Ratio	bStdX	b	Odds Ratio	bStdX	b	Odds Ratio	bStdX
Number of Boys	0.26*	1.29	0.32	0.26*	1.30	0.32	0.25*	1.29	0.31	0.25*	1.29	0.3151	0.08*	1.08	0.10	0.08*	1.08	0.098
Number of Dead Children	-0.38*	0.68	-0.25	-0.37*	0.69	-0.25	-0.42*	0.66	-0.28	-0.41*	0.66	-0.273	-0.05	0.95	-0.03	-0.03	0.97	-0.023
Han Status	0.56*	1.75	0.17	0.55*	1.74	0.17	0.48*	1.62	0.15	0.48*	1.62	0.1465	0.43*	1.53	0.13	0.42*	1.52	0.127
Three-Generation Familial Structure	-0.92*	0.40	-0.25	-0.94*	0.39	-0.25	-0.88*	0.41	-0.24	-0.88*	0.41	-0.238	-0.63*	0.53	-0.17	-0.67*	0.51	-0.180
No One-child Certificate	1.17*	3.22	0.43	1.21*	3.34	0.44	1.15*	3.15	0.42	1.15*	3.16	0.4218	0.84*	2.31	0.31	1.00*	2.72	0.366
Experience of Childbirth with Quota	-1.02*	0.36	-0.48	-1.03*	0.36	-0.49	-0.95*	0.39	-0.45	-0.97*	0.38	-0.4578	-0.68*	0.51	-0.32	-0.69*	0.50	-0.325
Wife's Education	-0.01*	0.99					-0.01*	0.99	-0.04				-0.01	0.99	-0.04			
Husband's Education			-0.05	0.01*	1.01	0.04				0.01*	1.01	0.0361				0.01	1.01	0.038
Wife's Age	-0.02*	0.98	-0.23	-0.02*	0.98	-0.21	-0.03*	0.97	-0.29	-0.03*	0.97	-0.2665	0.01*	1.01	0.12	0.01*	1.01	0.107
Married More than 14 years	0.19*	1.21	0.09	0.20*	1.22	0.10	0.21*	1.23	0.10	0.21*	1.24	0.1069	-0.04	0.96	-0.02	0.00	1.00	-0.001
Wife's Agricultural Occupation	0.23*	1.26	0.10				-0.02	0.98	-0.01				1.12*	3.07	0.49			
Husband's Agricultural Occupation				0.16*	1.17	0.07				0.10*	1.10	0.0454				0.25*	1.28	0.116
Living in Rural Area	-0.03	0.97	-0.01	0.10*	1.11	0.04	0.02	1.02	0.01	0.00	1.00	-0.0002	-0.28*	0.75	-0.11	0.41*	1.50	0.158
constant	-1.49			-1.75*			-1.37			-1.63*			-4.82*			-4.87*		
LR chi2:	3980.250			3963.391			2982.260			2986.206			795.108			676.743		
Prob > LR:	0.000			0.000			0.000			0.000			0.000			0.000		
McFadden's Adj(Pseudo) R2:	0.103			0.102			0.084			0.084			0.054			0.045		

Note: * $p<0.05$. ▲ bStdX: semi-standardized hazard ratio

Source: SFPCC 1989

Table 6.7 Micro-level Logistic Regression Models Predicting Three Sterilization Status for 1992 Taiwan Data.

	Couple Sterilization Status					
	Model I (Wife's Education and Wife's Agricultural Occupation)			Model II (Husband's Education and Husband's Agricultural Occupation)		
	b	Odds Ratio	bStdX▲	b	Odds Ratio	bStdX
Number of Boys	0.63*	1.88	0.57	0.64 *	1.90	0.58
Number of Dead Children	-0.05	0.95	-0.01	-0.05	0.95	-0.012
Three-Generation Familial Structure	0.05	1.05	0.02	0.06	1.06	0.027
Nowork Status	0.06	1.06	0.03	0.03	1.03	0.014
Mainlander Status	-0.23*	0.79	-0.08	-0.23*	0.79	-0.080
Whether owning Piano	0.27*	1.31	0.09	0.25	1.28	0.082
Wife's Education	-0.09*	0.92	-0.32			
Husband's Education				-0.08*	0.92	-0.287
Wife's Age	0.07*	1.07	0.40	0.08	1.08	0.449
Wife's Agricultural Occupation	0.57*	1.76	0.10			
Husband's Agricultural Occupation				0.38	1.46	0.096
constant	-3.51*			-3.78*		
LR chi2:	1857.855			1832.659		
Prob > LR:	0.000			0.000		
McFadden's Adj(Pseudo) R2:	0.135			0.134		

	Wife Sterilization Status					
	Model I (Wife's Education and Wife's Agricultural Occupation)			Model II (Husband's Education and Husband's Agricultural Occupation)		
	b	Odds Ratio	bStdX	b	Odds Ratio	bStdX
Number of Boys	0.63*	1.88	0.57	0.64*	1.90	0.58
Number of Dead Children	-0.02	0.98	0.00	-0.02	0.98	-0.004
Three-Generation Familial Structure	0.06	1.06	0.03	0.074	1.08	0.036
Nowork Status	0.07	1.07	0.03	0.037	1.04	0.017
Mainlander Status	-0.35*	0.70	-0.12	-0.35*	0.71	-0.120
Whether owning Piano	0.25*	1.28	0.08	0.23*	1.26	0.077
Wife's Education	-0.09*	0.91	-0.35			
Husband's Education				-0.09*	0.92	-0.315
Wife's Age	0.06*	1.06	0.36	0.07*	1.07	0.41
Wife's Agricultural Occupation	0.60*	1.83	0.11			
Husband's Agricultural Occupation				0.40*	1.50	0.102
constant	-3.31*	0.28		-3.58*		
LR chi2:	1819.192			1798.077		
Prob > LR:	0.000			0.000		
McFadden's Adj(Pseudo) R2:	0.136			0.134		

	Husband Sterilization Status					
	Model I (Wife's Education and Wife's Agricultural Occupation)			Model II (Husband's Education and Husband's Agricultural Occupation)		
	b	Odds Ratio	bStdX	b	Odds Ratio	bStdX
Number of Boys	0.21*	1.23	0.19	0.21*	1.24	0.19
Number of Dead Children	-0.63	0.53	-0.15	-0.63	0.53	-0.15
Three-Generation Familial Structure	-0.23	0.80	-0.11	-0.23	0.80	-0.11
Nowork Status	-0.14	0.87	-0.07	-0.12	0.89	-0.06
Mainlander Status	0.71*	2.04	0.25	0.66	1.94	0.23
Whether owning Piano	0.29	1.34	0.10	0.25	1.29	0.08
Wife's Education	0.04	1.04	0.15			
Husband's Education				0.05*	1.05	0.19
Wife's Age	0.11*	1.11	0.62	0.10*	1.11	0.61
Wife's Agricultural Occupation	-0.74	0.48	-0.13			
Husband's Agricultural Occupation				-0.63	0.53	-0.16
constant	-8.71*	0.28		-8.82*		
LR chi2:	91.496			95.191		
Prob > LR:	0.000			0.000		
McFadden's Adj(Pseudo) R2:	0.041			0.043		

Note: * p<0.05. ▲ bStdX: semi-standardized hazard ratio

Source: TPIFP 1992

who do not own a one-child certificate and who have a 222% higher probability of being sterilized than those with this certificate.

For each increment in age of the women, other things equal, the odds of being sterilized are multiplied by 0.98 of the odds ratio; that is, couples probability of sterilization decrease by 2%. This is also the case for the wife sterilization model, but not for the male sterilization model.

For each additional son, other things equal, the odds of being sterilized are multiplied by 1.29 of the odds ratio; that is, the couple's probability of sterilization increases by 29 %. This is in agreement with the hypothesis that when couples have more sons to satisfy the aspiration of son preference, they may feel that their fertility mission has been fulfilled. Other predictors also comport with the hypothetical expectations for influence on sterilization status. Other things being equal, the odds of having had sterilization are 1.21 times higher for the group married more than 14 years than for the group married less than 14 years. Han status increases the odds of sterilization by 75%, while three-generation familial structures lower the odds of sterilization by 60%.

For the wife's sterilization status in Models I and II in Table 6.6, the results are almost identical to the couple sterilization status because women are more often the partner who is sterilized. The wife's agricultural occupation variable shows no statistical significance, but the husband's agricultural status is positively related to the wife's sterilization. That means that whether the wife's occupation is farming does not influence the wife's sterilization status. Neither the wife's nor the husband's educational status affects the husband's sterilization status. Also failing to pass the significance test are the predictors Number of children and whether or not married more than 14 years. Notably, the wife's agricultural occupation variable not only is statistically significant, but also shows the strongest effect in terms of the semi-standardized coefficients. Other things being equal, the odds of one's husband's sterilization are 3.07 times higher for farming wives than for other wives.

In Table 6.7, Taiwan sterilization logistic models, number of boys is the most important predictor for the models of couple's sterilization and wife's sterilization; for the husband's sterilization models, wife's age is the most important predictor. Number of dead children, three-generation familial structure, and wife without work status fail to pass the significance test. Owning piano status, and wife's and husband's agricultural occupation status have affirmative effects on the couple's and wife's sterilization model, but not on the male sterilization model. Other things being equal, Mainlander status decreases the odds of couple's and wife's sterilization by an average of 20%. But the odds of the husband's being sterilized for is almost 100% more for Mainlanders than for non-Mainlanders.

Survival Analysis

Tables 6.8 and 6.9, for China and Taiwan, respectively, display Cox proportional hazards models for the hazard of having first, second, and third childbirth. The last two models in each table (for second childbirth and third) have two more variables: whether.

Table 6.8 Cox Proportional Hazards Models for the Hazard of Having First to Third Childbirth for 1988 China Data.

	The First Childbirth						The Second Childbirth						The Third Childbirth					
	Model I (Wife's Education and Wife's Agricultural Occupation)			Model II (Husband's Education and Husband's Agricultural			Model I (Wife's Education and Wife's Agricultural Occupation)			Model II (Husband's Education and Husband's Agricultural			Model I (Wife's Education and Wife's Agricultural Occupation)			Model II (Husband's Education and Husband's Agricultural Occupation)		
	b	Haz. Ratio	bStdX▲	b	Haz. Ratio	bStdX	b	Haz. Ratio	bStdX	b	Haz. Ratio	bStdX	B	Haz. Ratio	bStdX	b	Haz. Ratio	bStdX
Previous child born was a boy							-0.05*	0.95	0.98	-0.05*	0.95	0.98	-0.14*	0.87	0.94	-0.14*	0.87	0.94
Previous child born was dead child							0.42*	1.52	1.15	0.42*	1.52	1.15	0.28*	1.32	1.14	0.27*	1.32	1.14
Han Status	0.14*	1.15	1.04	0.14*	1.16	1.04	0.01	1.01	1.00	0.01	1.01	1.00	-0.11*	0.90	0.97	-0.11*	0.90	0.97
Three-Generation Familial Structure	0.13*	1.14	1.03	0.12*	1.13	1.03	0.29*	1.34	1.08	0.29*	1.34	1.08	0.17*	1.19	1.05	0.17*	1.19	1.05
No One-child Certificate	0.05*	1.05	1.02	0.02	1.02	1.01	0.33*	1.39	1.13	0.32*	1.38	1.13	0.29*	1.34	1.11	0.30*	1.35	1.12
Experience of Childbirth with Quota	-0.23*	0.79	0.90	-0.22*	0.80	0.90	0.26*	1.29	1.13	0.26*	1.29	1.13	0.50*	1.65	1.27	0.50*	1.65	1.27
Wife's Education	0.03*	1.03	1.13				0.01*	1.01	1.02				0.00	1.00	0.99			
Husband's Education				0.01*	1.01	1.02				0.01*	1.01	1.02				0.00	1.00	1.00
Wife's Age	-0.04*	0.96	0.66	-0.05*	0.96	0.64	-0.02*	0.98	0.82	-0.02*	0.98	0.93	-0.01*	0.99	0.91	-0.01*	0.99	0.91
Married More than 14 years	-0.17*	0.84	0.92	-0.18*	0.83	0.91	0.21*	1.23	1.11	0.21*	1.23	7.70	0.07*	1.08	1.04	0.08*	1.08	1.04
Wife's Agricultural Occupation	-0.11*	0.90	0.95				-0.05*	0.95	0.98				0.08*	1.08	1.03			
Husband's Agricultural Occupation				-0.17*	0.84	0.92				-0.04*	0.96	0.98				0.07*	1.07	1.03
Living in Rural Area	0.33*	1.38	1.13	0.27*	1.31	1.11	-0.05*	0.95	0.98	-0.08*	0.93	0.97	-0.01	0.99	1.00	0.01	1.01	1.00
LR chi2:	6190.910			5979.310			1728.010			1726.430			1971.160			1972.630		
Prob > LR:	0.000			0.000			0.000			0.000			0.000			0.000		
Pseudo R2:	0.013			0.012			0.003			0.003			0.005			0.005		

Note: * $p<0.05$. ▲ bStdX: semi-standardized hazard ratio

Source: SFPCC 1989

Table 6.9 Cox Proportional Hazards Models for the Hazard of Having First to Third Childbirth for 1992 Taiwan Data.

	The First Childbirth						The Second Childbirth						The Third Childbirth					
	Model I (Wife's Education and Wife's Agricultural Occupation)			Model II (Husband's Education and Husband's Agricultural			Model I (Wife's Education and Wife's Agricultural Occupation)			Model II (Husband's Education and Husband's Agricultural			Model I (Wife's Education and Wife's Agricultural Occupation)			Model II (Husband's Education and Husband's Agricultural		
	b	Haz. Ratio	bStdX▲	b	Haz. Ratio	bStdX	b	Haz. Ratio	bStdX	b	Haz. Ratio	bStdX	b	Haz. Ratio	bStdX	b	Haz. Ratio	bStdX
Previous child born was a boy							-0.13*	0.87	0.98	-0.13*	0.87	0.94	-0.58*	0.55	0.76	-0.56*	0.56	0.77
Previous child born was dead child							0.57*	1.71	1.00	0.59*	1.77	1.01	0.82*	2.37	1.16	0.83*	2.43	1.17
Three-Generation Familial Structure	0.07*	1.06	1.03	0.07*	1.07	1.04	0.09*	1.10	1.22	0.10*	1.11	1.04	0.17*	1.24	1.08	0.17*	1.24	1.09
Nowork Status	0.03	1.04	1.01	0.04*	1.05	1.02	0.00	1.01	1.03	0.00	1.01	1.00	0.05	1.06	1.02	0.03	1.04	1.01
Mainlander Status	-0.19*	0.82	0.94	-0.18*	0.83	0.94	-0.34*	0.70	1.00	-0.34*	0.70	0.95	-0.37*	0.68	0.88	-0.34*	0.70	0.89
Whether owning Piano	0.06*	1.07	1.02	0.07*	1.07	1.02	0.03	1.04	0.96	0.02	1.02	1.00	-0.07	0.93	0.98	-0.11*	0.90	0.96
Wife's Education	-0.02*	0.98	0.93				-0.04*	0.95	1.35				-0.09*	0.91	0.72			
Husband's Education				-0.02*	0.97	0.92				-0.04*	0.96	1.14				-0.08*	0.92	0.76
Wife's Age	-0.01*	0.99	0.49	-0.01*	0.99	0.94	0.01*	1.01	0.23	0.01*	1.01	0.47	0.01*	1.02	1.09	0.02*	1.02	1.14
Wife's Agricultural Occupation	-0.20*	0.83	1.00				-0.01	0.99	1.00				0.31*	1.34	1.06			
Husband's Agricultural Occupation				-0.08*	0.93	0.98				0.06	1.06	1.00				0.39*	1.47	1.10
LR chi2:	161.560			167.440			645.130			627.280			1574.050			1482.210		
Prob > LR:	0.000			0.000			0.000			0.000			0.000			0.000		
Pseudo R2:	0.001			0.001			0.004			0.004			0.015			0.014		

Note: * $p<0.05$. ▲ bStdX: semi-standardized hazard ratio

Source: TPIFP 1992

the previous child born was a boy and whether the previous childbirth was a dead childbirth (i.e., the previous childbirth was miscarried, stillborn, or died within one year).

To test the null hypothesis that all the X variables' coefficients are zero (this is similar to the previous logistic analysis), values of LR chi-square ($\boldsymbol{LR\chi^2}$), are examined, which are in the third line from the bottom of Tables 6.8 and 6.9. All of the probabilities of a greater value of $\boldsymbol{LR\chi^2}$ are P = 0.000, so I reject the null hypothesis that the coefficients on all independent variables are all zero. **Pseudo $\mathbf{R^2}$** in the bottom row indicates how well the model fits the data.

In the first childbirth columns of Table 6.8, all predictors pass the significance test for Model I and Model II, except experience in childbirth with quota. The important women's status variables in Table 6.8 are the positive hazard coefficient for wife's educational level and the negative hazard coefficient for wife's agriculture occupation. This suggests that women whose schooling increases one more year, have a significantly higher probability of going on to have a first birth. Its hazard ratio is 1.03. This means that among married Chinese women, obtaining one more schooling year increases the hazard of having a first birth by 3% or [100(1.03-1=.03)]=3. This is net of the effects of the other co-variates. For women's agriculture occupation's hazard ratio, it means that among married Chinese women, being a farmer decreases the hazard of having a first birth by 10% or [100(.90-1=.10)] =10. This is contrary to the theoretical hypothesis, as is the husband's agricultural occupation. Also opposed to the hypotheses: (1) adding one year to wife's age decreases the hazard of having a first birth by 4%, (2) being the group married more than 14 years reduces the hazard by 16%, and (3) being Han increases the hazard by 15%. The other predictors, however, are in agreement with the hypotheses. Three-generation familial structure, no one-child certificate, and living in rural area have positive effects on transition to the first childbirth after marriage. Comparing these semi-standardized coefficients across predictors, we see the first three relatively important factors are living in rural area, wife's education and Han status.

In the models of the second childbirth, only Han status shows no statistical significance. The two new predictors--whether the previous child born was a boy and whether last birth was dead child--agree with the hypotheses presented earlier. To have a boy reduces the hazard of transition to a second childbirth by 5%; to experience having lost children increases the hazard of proceeding to a second childbirth by 52%. Three predictors change their direction of influence. Experience of childbirth with quota increases the hazard of having a second childbirth by 29%. Living in rural area lowers the hazard by 5%. Neither of these results is in line with the hypotheses posited for this dissertation. However, being married more than 14 years increases by 23% the hazard of having a second child, which comports with the relevant hypothesis. In terms of the semi-standardized coefficients, the first three relatively important predictors are whether the previous childbirth was a dead child, no one-child certificate, and experience of childbirth with quota.

In the models of the third childbirth, wife's and husband's education no longer show significant influence, nor does living in a rural area. Han status, however, again shows a significant effect, but it changes to reduce the hazard of proceeding to the third childbirth by 10%. Wife's and husband's agricultural occupation also show directional change in that they increase by 8% the hazard of having the third childbirth. This transformation agrees with the hypothesis. Evaluating the semi-standardized coefficients, the first three relatively important predictors are the same as for the model of the second childbirth--whether the previous child born was a dead child, no one-child certificate, and experience of childbirth with quota. The survival analysis of 1988 China data demonstrates the degree to which the predictors influence childbirth of different parity. In this analysis, son preference is empirically affirmed again. The two fertility-policy variables play important roles in affecting higher parity fertility, but women's educational status shows no effect on the third parity.

In the first childbirth columns of Table 6.9 for the 1992 Taiwan data, no-work status in Model I and husband's agriculture occupation in Model II fail to pass the significance test, but the rest of the predictors pass the significance test. In Table 6.9, both the hazard coefficient for wife's educational level and the hazard coefficient for wife's agriculture occupation are negative. This connotes that women whose schooling increases one more year, have a significantly diminished probability of going on to have a first birth. Its hazard ratio is 0.98. This means that among married Taiwanese women, attaining one more schooling year shrinks the hazard of having a first birth by 2% or [100(.98-1=.02)]=-2. This is net of the effects of the other co-variates. For wife's agriculture occupation's hazard ratio, it means that among married Taiwanese women, being a farmer diminishes the hazard of having a first birth by 17% or [100(.83-1=.10)] =17. The effect of the wife's increased schooling is in accord with the hypothesis, and so is the effect of the husband's educational level in Model II. The negative effect of the wife's agriculture occupation does not, however, conform with expectations, nor does the effect of the husband's agricultural occupation. As with China's data, adding one more year to the wife's age decreases the hazard of having a first child by 1%. Owning-piano status encourages the first childbirth by 7%. on the other hand, two other predictors are in agreement with the hypotheses. Three-generation familial structure has a positive effect on transition to the first childbirth after marriage by 6%. Being a Mainlander lessens the hazard of having a second child by 18%. Comparing these semi-standardized coefficients across predictors, we see that the two relatively more important factors are the three-generation familial structure and owning a piano (the wealth effect).

In the models of the second childbirth, no work status, owning piano, and agriculture occupation in Model I and Model II lose statistical significance. Both of the new predictors--whether the previous child born was a boy and whether the previous birth was a dead child, support the hypotheses. Having had a boy reduces the hazard to a second childbirth by 5%; having lost a child increases the hazard of a second childbirth by 71%. Wife's age is a predictor that changes its direction of affecting the transition to the next childbirth. Increasing the wife's age one more year increases the hazard of having a second childbirth by1%. In terms of the semi-standardized coefficients, the most important predictors are family structure, education status, and having experienced losing a child.

In the models of the third childbirth, no work status and owning piano fail to pass the significance test. Wife's and husband's agricultural occupation switch to increase the hazard of having the third childbirth by 34%. This transformation is similar to China's situation. Evaluating the semi-standardized coefficients, the first three relatively important predictors are whether the previous child born was a dead child, family structure, and wife's age. It is different from China that in Taiwan adding a year to the wife's age increases the probability of having the third childbirth. When women in China increase their age, there is less of a probability to have a third childbirth. From the survival analysis of the 1992 Taiwan data, we see that without strong policy interference, family structure demonstrates its influence on fertility. Son preference is also empirically affirmed in this analysis. In addition, losing children shows a stronger effect than son preference. In Taiwan, women's education status retains its reducing effect through the third childbirth, which is not the case for China.

One way to describe the survival-time data is to graph their Kaplan-Meier (K-M) survivor functions (Kaplan and Meier 1958; Hamilton 1998). This function is defined as follows: For the first group of women, let $\mathbf{n_t}$ represent the number of women who have not given birth to a second child and are not censored at the beginning of time period **t**; $\mathbf{d_t}$ represents the number of second children born to these women during time period **t**. The formula (below) is the Kaplan-Meier estimator of surviving beyond time **t** (i.e., not having a second birth beyond time **t**), and is the product of survival probabilities in **t** and the preceding periods.

$\boldsymbol{n_t}$ represents the number of observations that have not failed (i.e. childbirths one to three not having occurred) and are not censored at the beginning of time period t; $\mathbf{d}_t$ represents the number of failures (the number of childbirths) that occur to these observations during time period t. The Kaplan-Meier estimator of surviving beyond time *t* is the product of survival probabilities in *t* and the preceding periods:

$$\mathbf{S(t)} = \prod_{j=t0}^{t} \{ (n_j - d_j)/ n_j \}$$

In Figures 6.5 and 6.6, I have graphed **S(t)** against the number of months between the marriage to the first birth, the first birth to the second birth, and the second birth to the third birth. The K-M survivor curve in Figure 6.5 for 1988 China data shows the probabilities of surviving the hazard of having the first to the third birth for each month of analysis time. The curve steps down rapidly from a probability of near 1.00 of surviving just a few months the hazard of having a childbirth, to a probability of around .15 by about the 200th month, leveling off by the 400th month to a probability of surviving having a birth of about .1. The second and the third birth curves are not so smooth as the first birth curve and require more months to step down. However, when comparing Figure 6.5 with Figure 6.6 for Taiwan 1992 data, it is obvious that the third birth curve for Taiwan looks very different than that for China.

The curve of the third birth in Taiwan spends almost 500 months to level off, while but China's does so in 200 months. From Figure 6.7 to Figure 6.12, I generate companion K-M survivor curves and inspect graphically the dichotomous predictors for the first birth to the third birth in the China and Taiwan data. In general, it is observed that there are more obviously different survivor curves associated with predictors in the first birth in China's data (such as family structure, rural area, and marriage group), but in Taiwan, that is seen in data for the third birth.

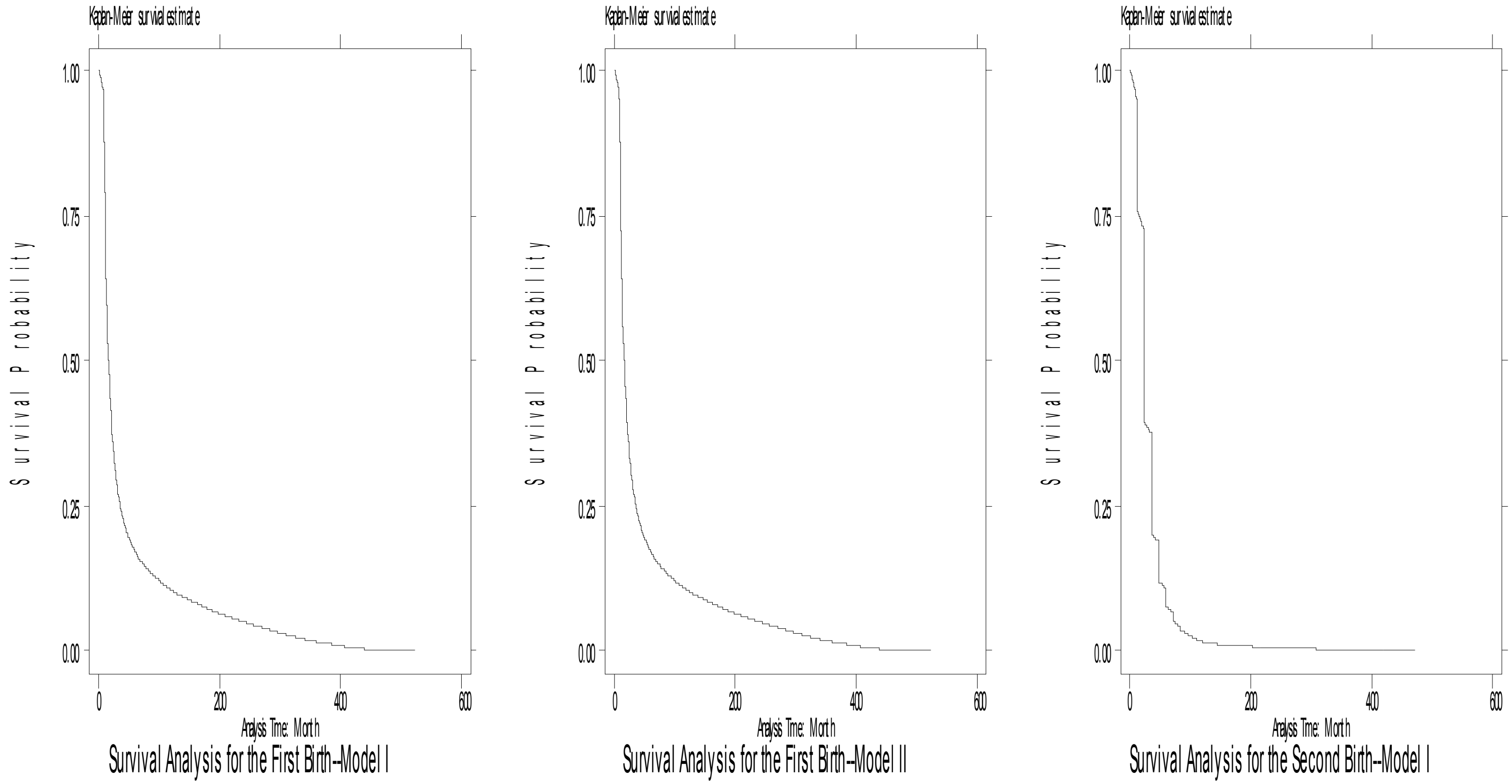
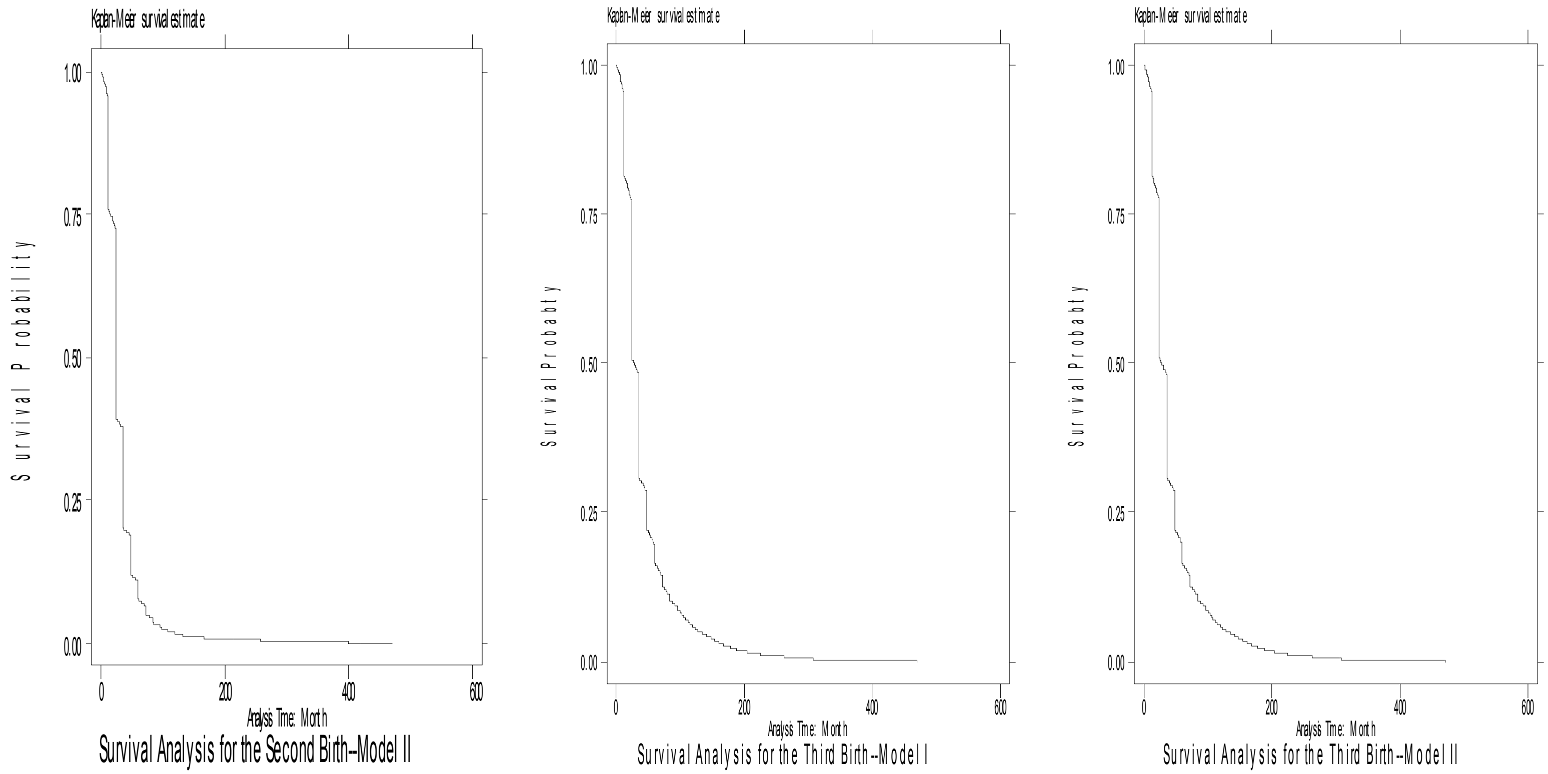


Figure 6.5 Probability of Surviving the Hazard of Having the First to Third Childbirth in 1988 China Data



Source: SFPCC 1989

Figure 6.5 (Continued)

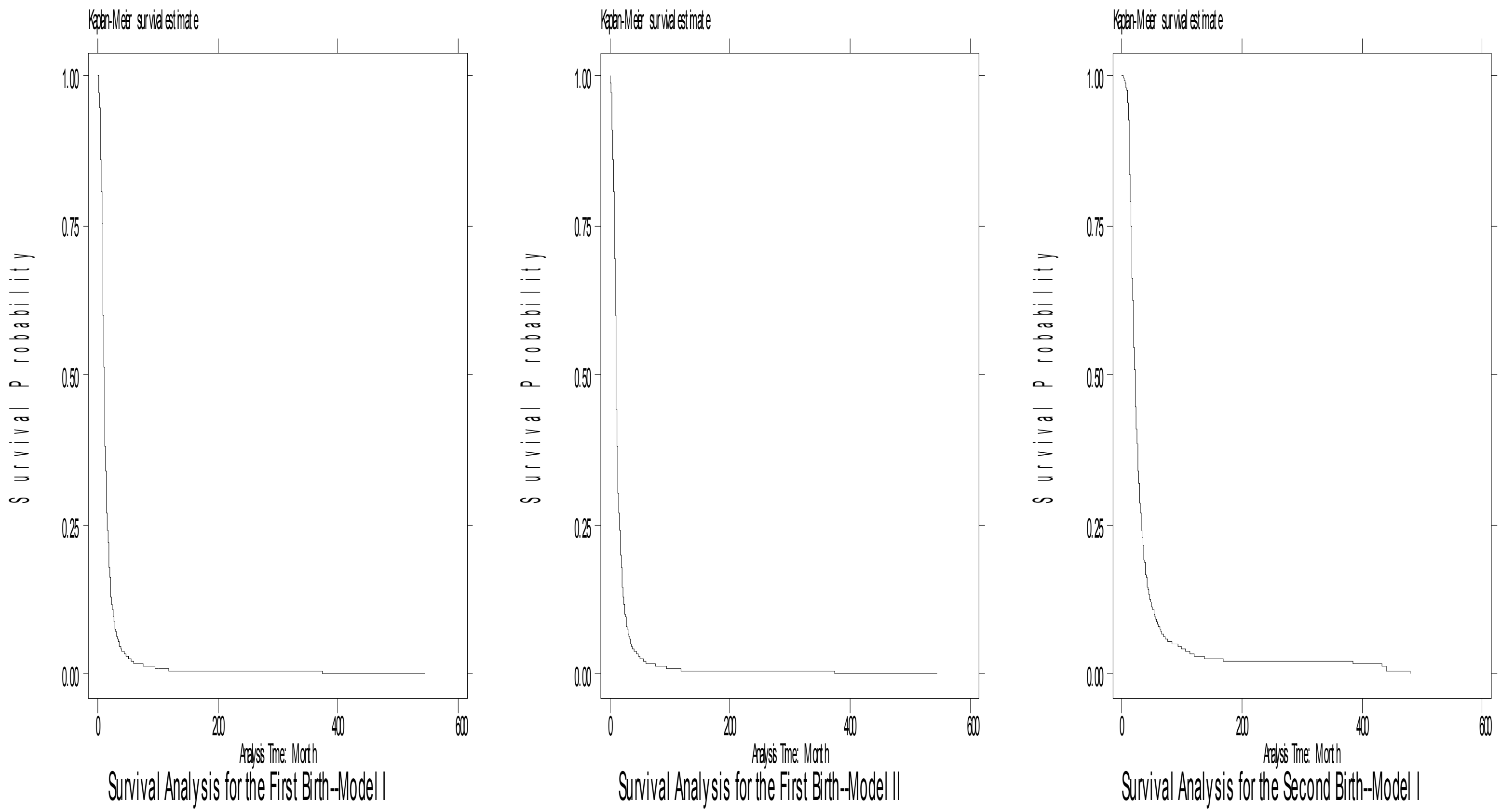
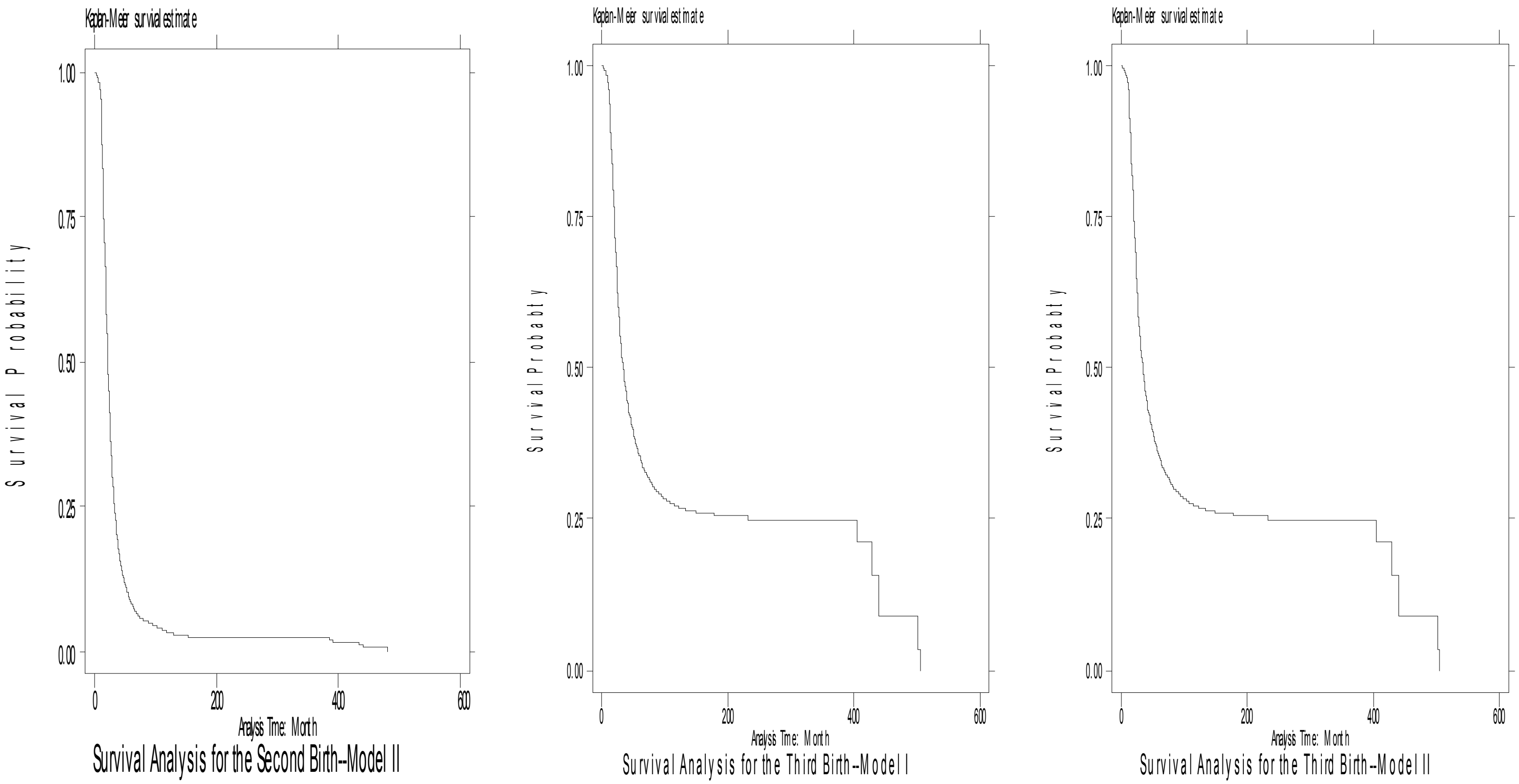


Figure 6.6 Probability of Surviving the Hazard of Having the First to Third Childbirth in 1992 Taiwan Data



Source: TPIFP 1992

Figure 6.6 (Continued)

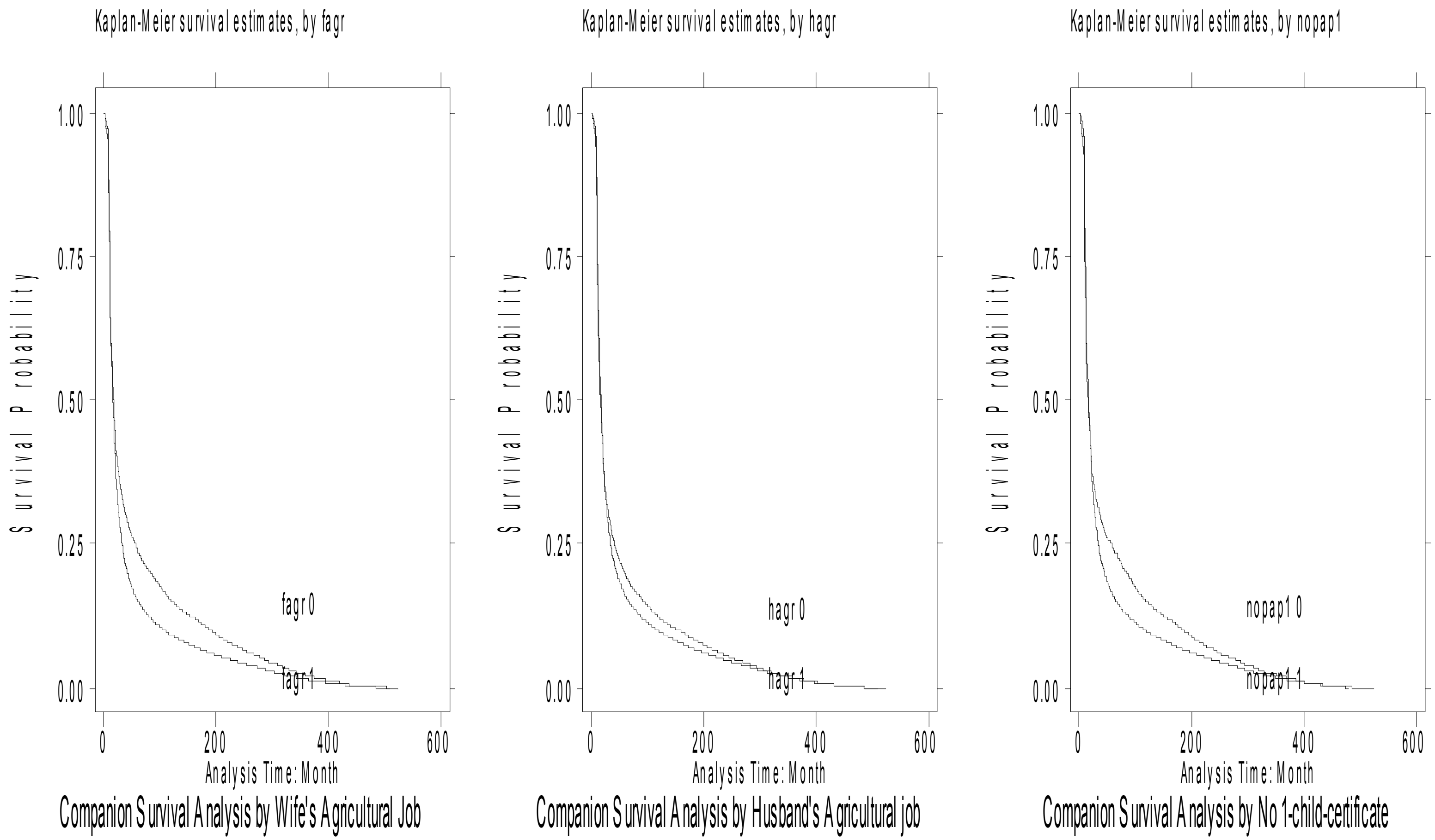
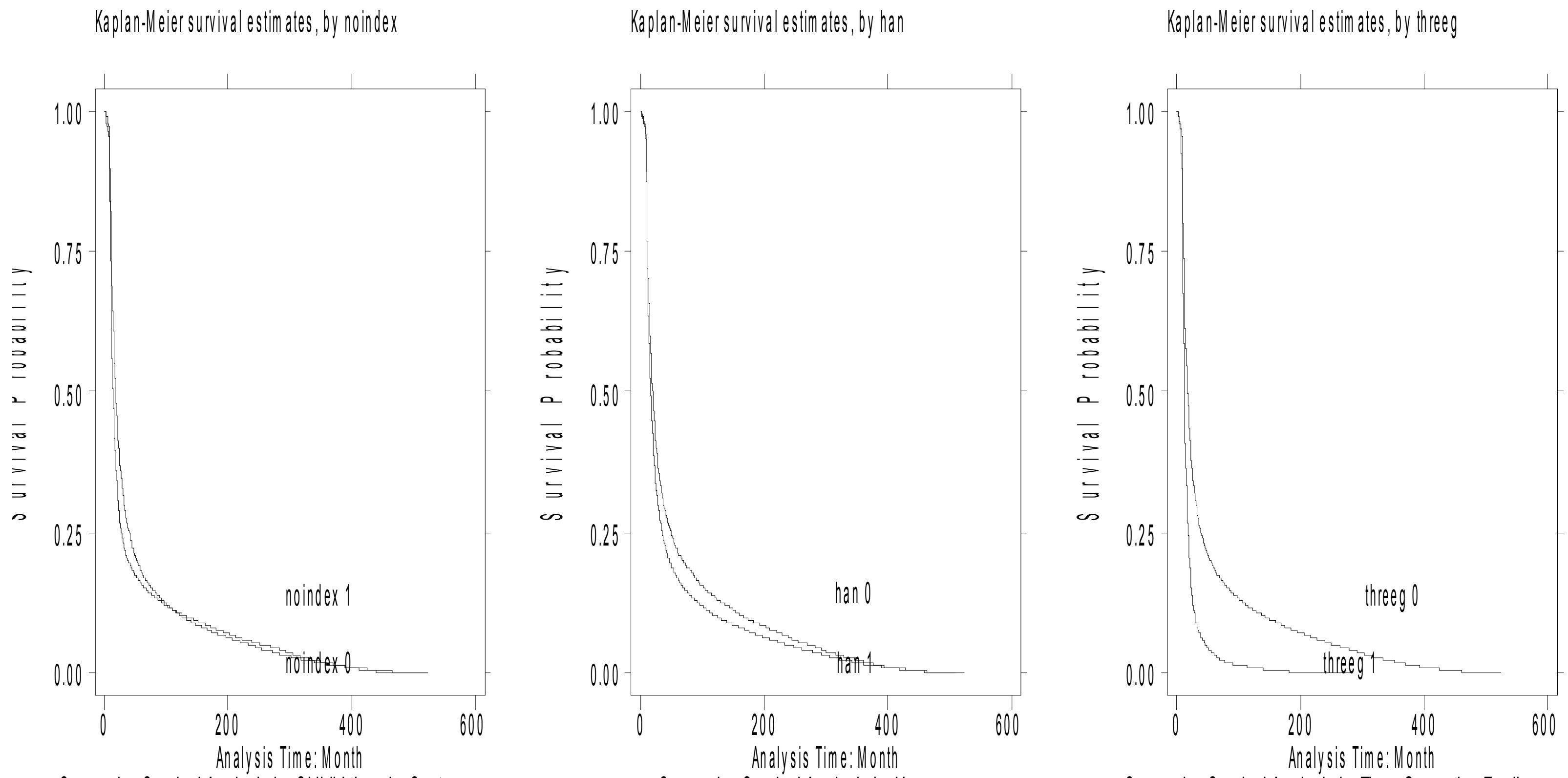


Figure 6.7 Probability of Surviving the Hazard of Having the First Childbirth in 1988 China Data, Stratified by Dichotomous Predictors

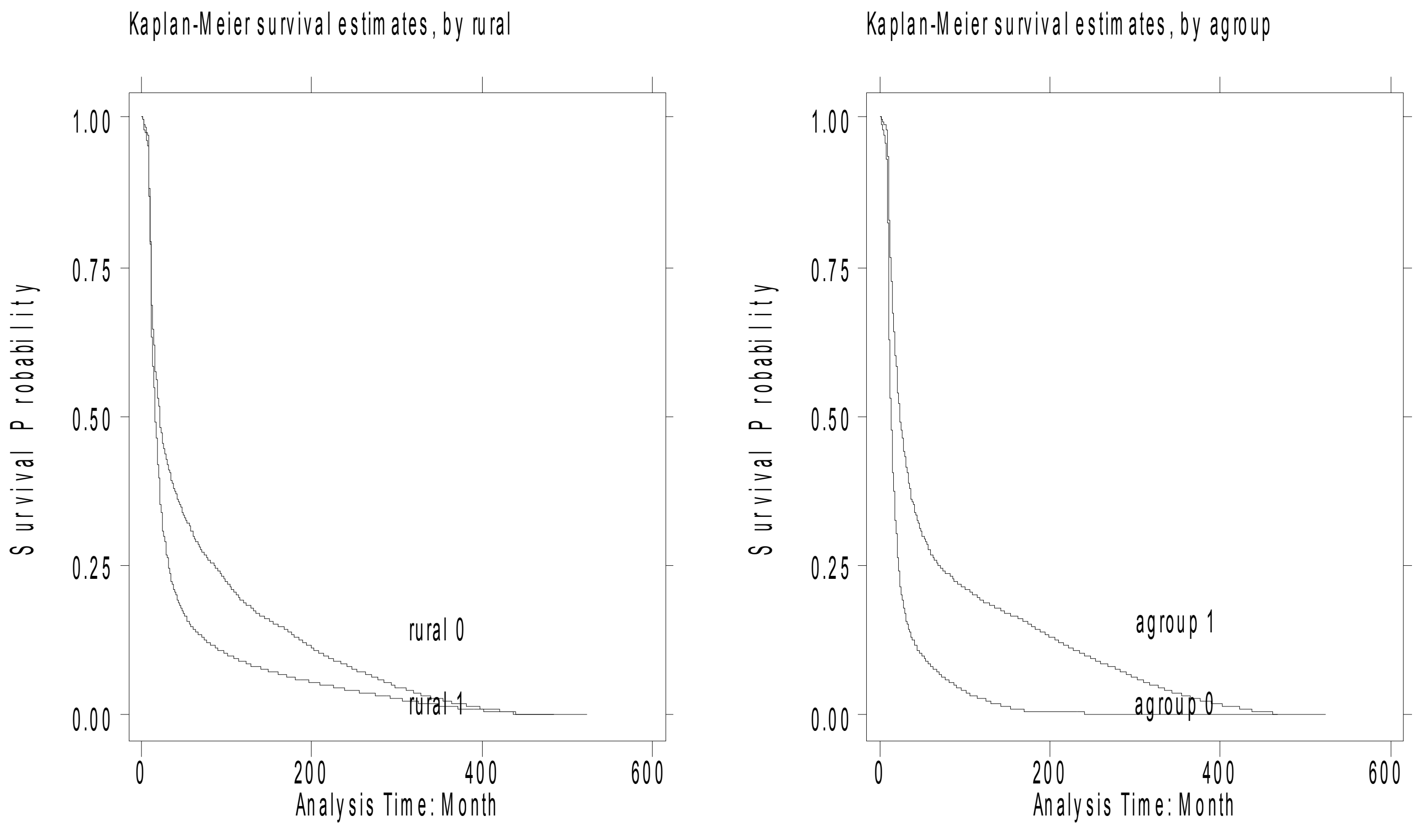


Companion Survival Analysis by Childbirth under Quota

Companion Survival Analysis by Han

Companion Survival Analysis by Three-Generation Family

Figure 6.7 (Continued)



Companion Survival Analysis by Rural/City area

Companion Survival Analysis by Old/Young Marriage Group

Source: SFPCC 1989

Figure 6.7 (Continued)

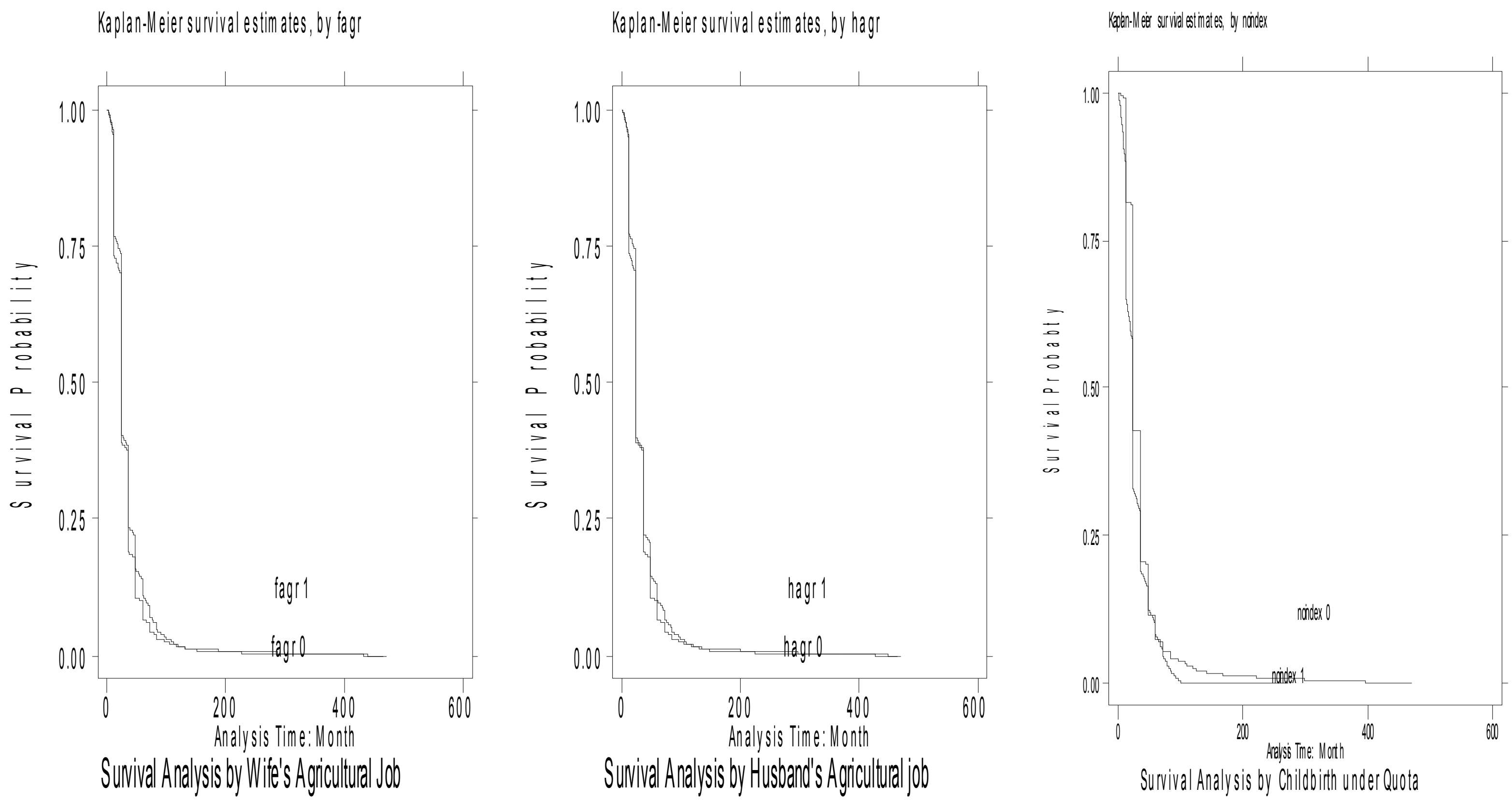


Figure 6.8 Probability of Surviving the Hazard of Having the Second Childbirth in 1988 China Data, Stratified by Dichotomous Predictors

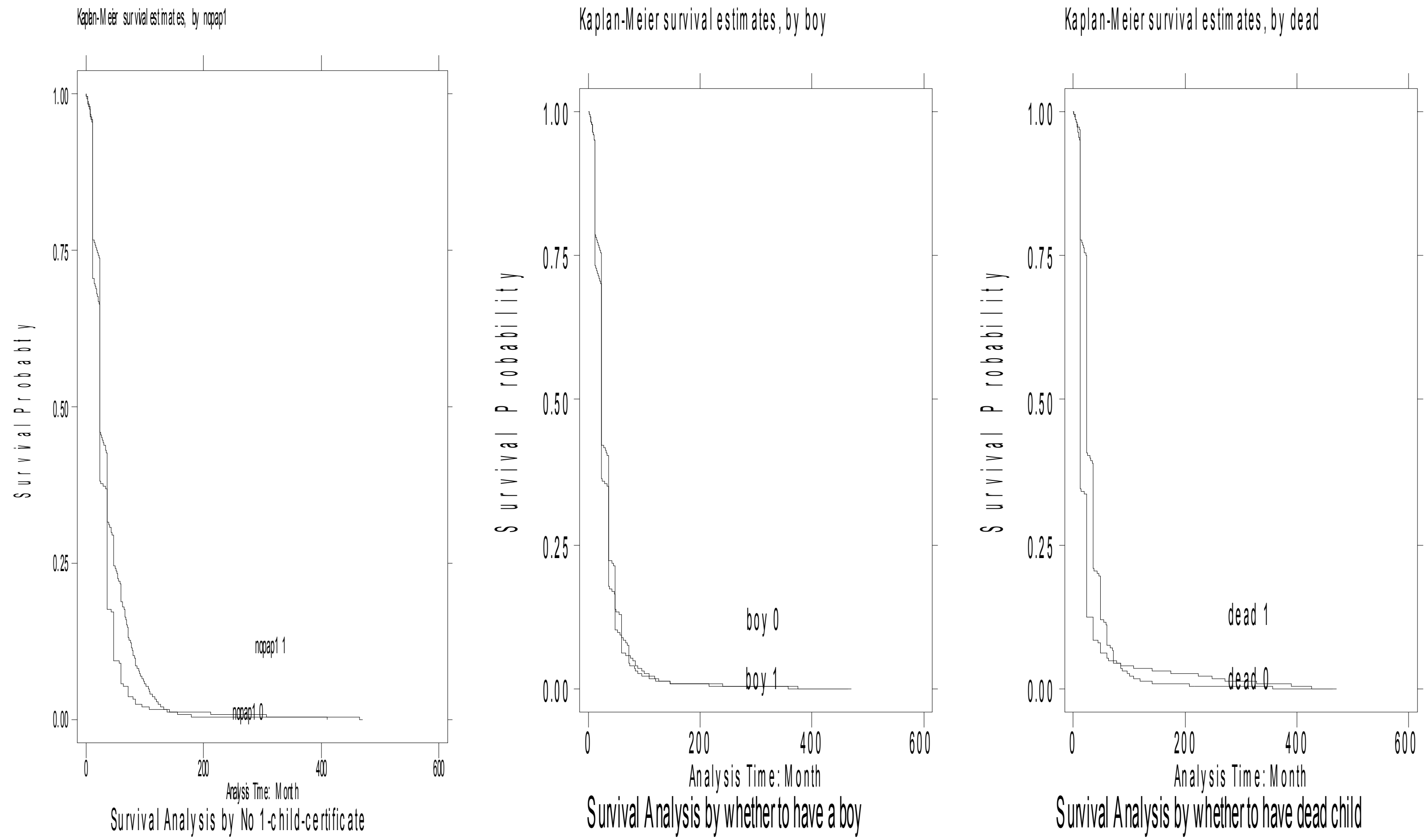
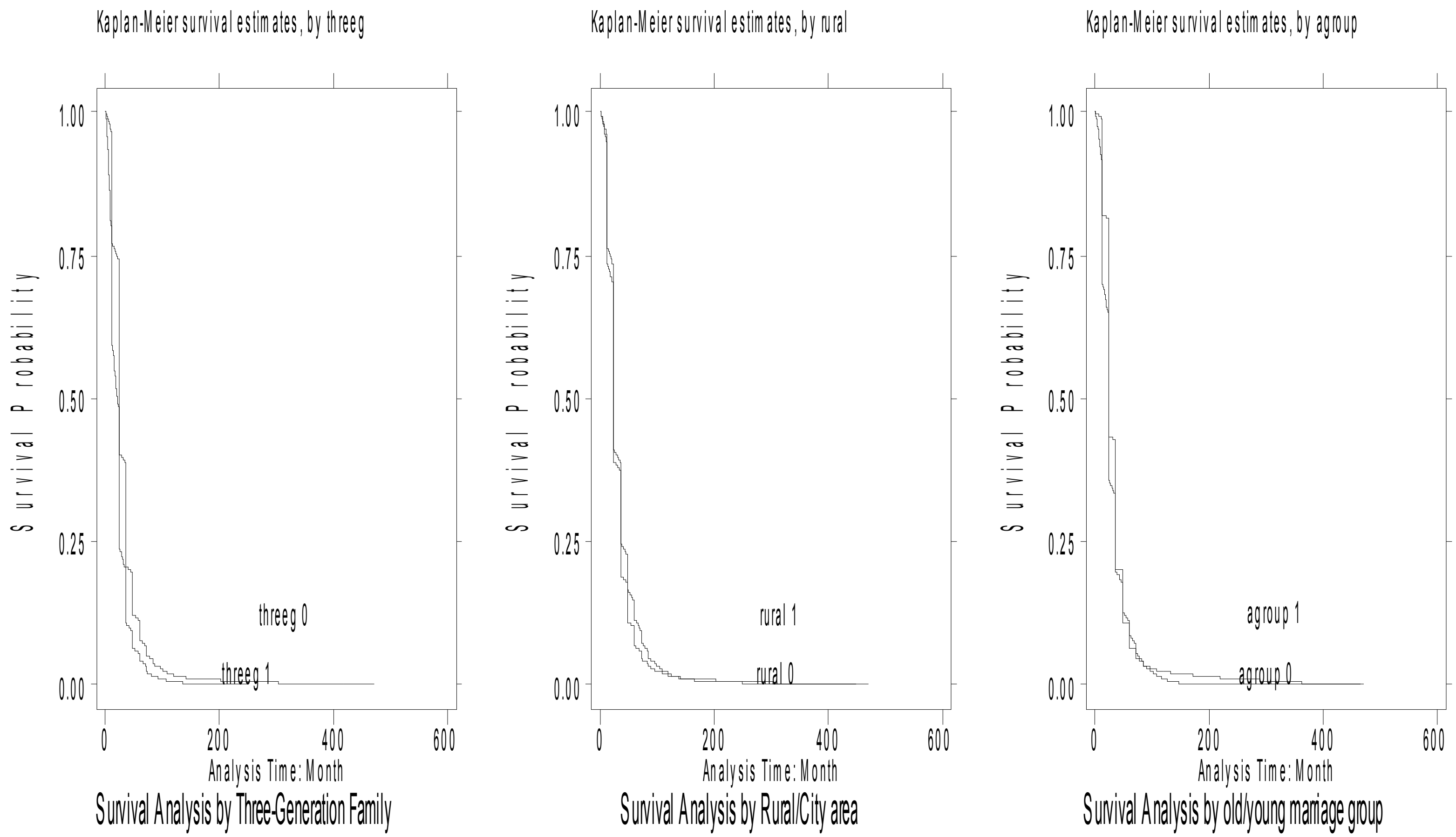


Figure 6.8 (Continued)



Source: SFPCC 1989

Figure 6.8 (Continued)

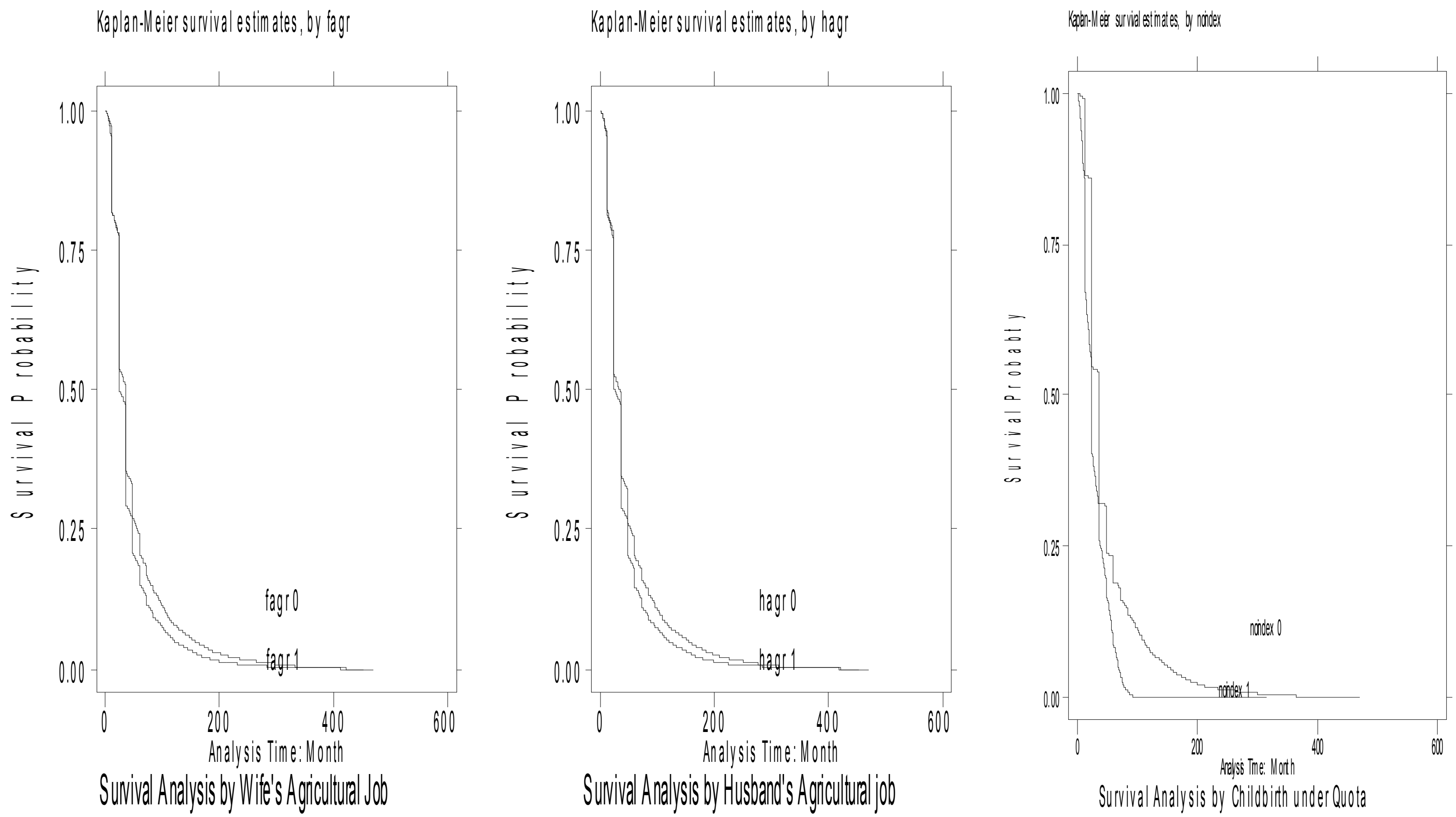


Figure 6.9 Probability of Surviving the Hazard of Having the Third Childbirth in 1988 China Data, Stratified by Dichotomous Predictors

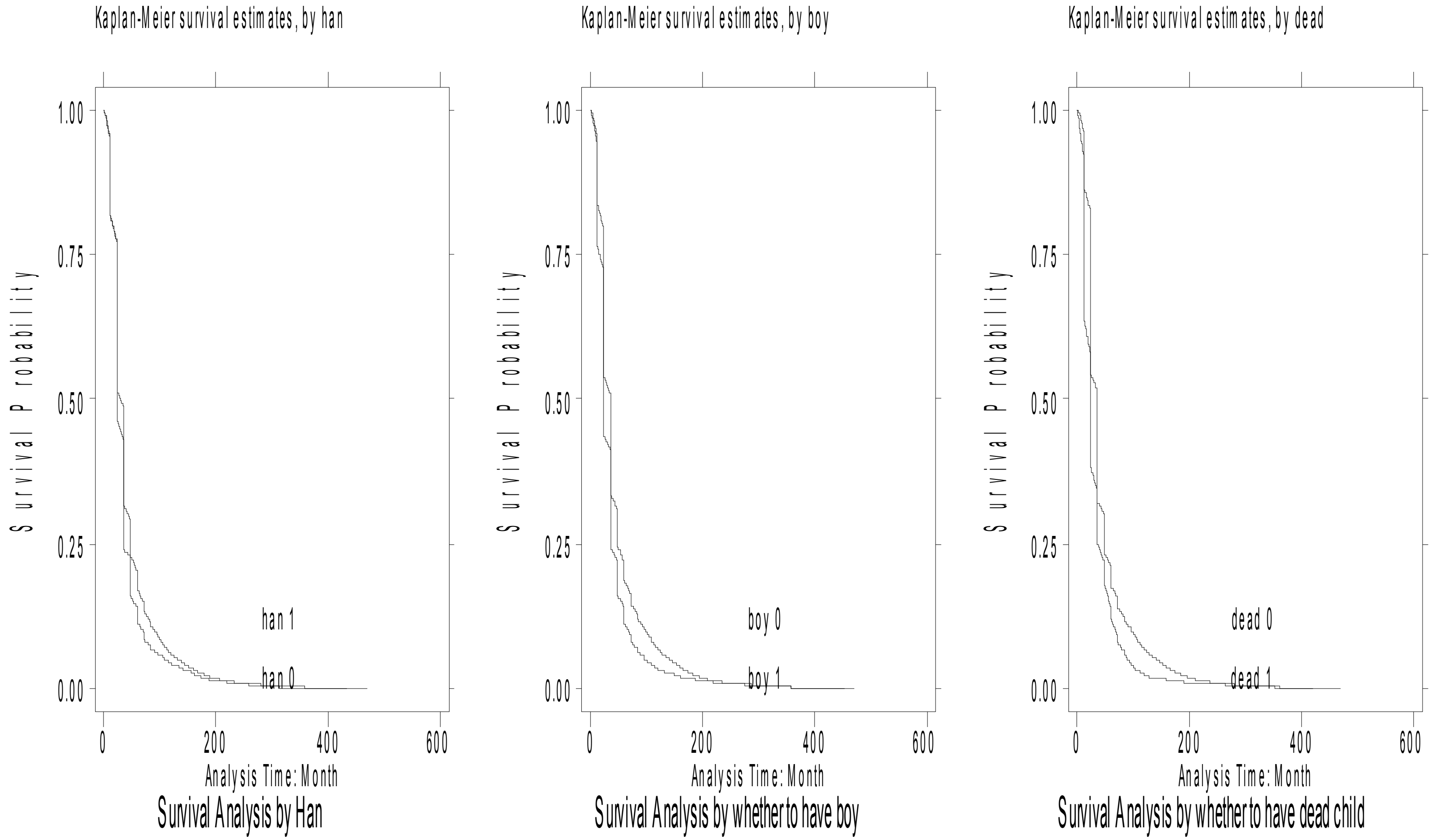
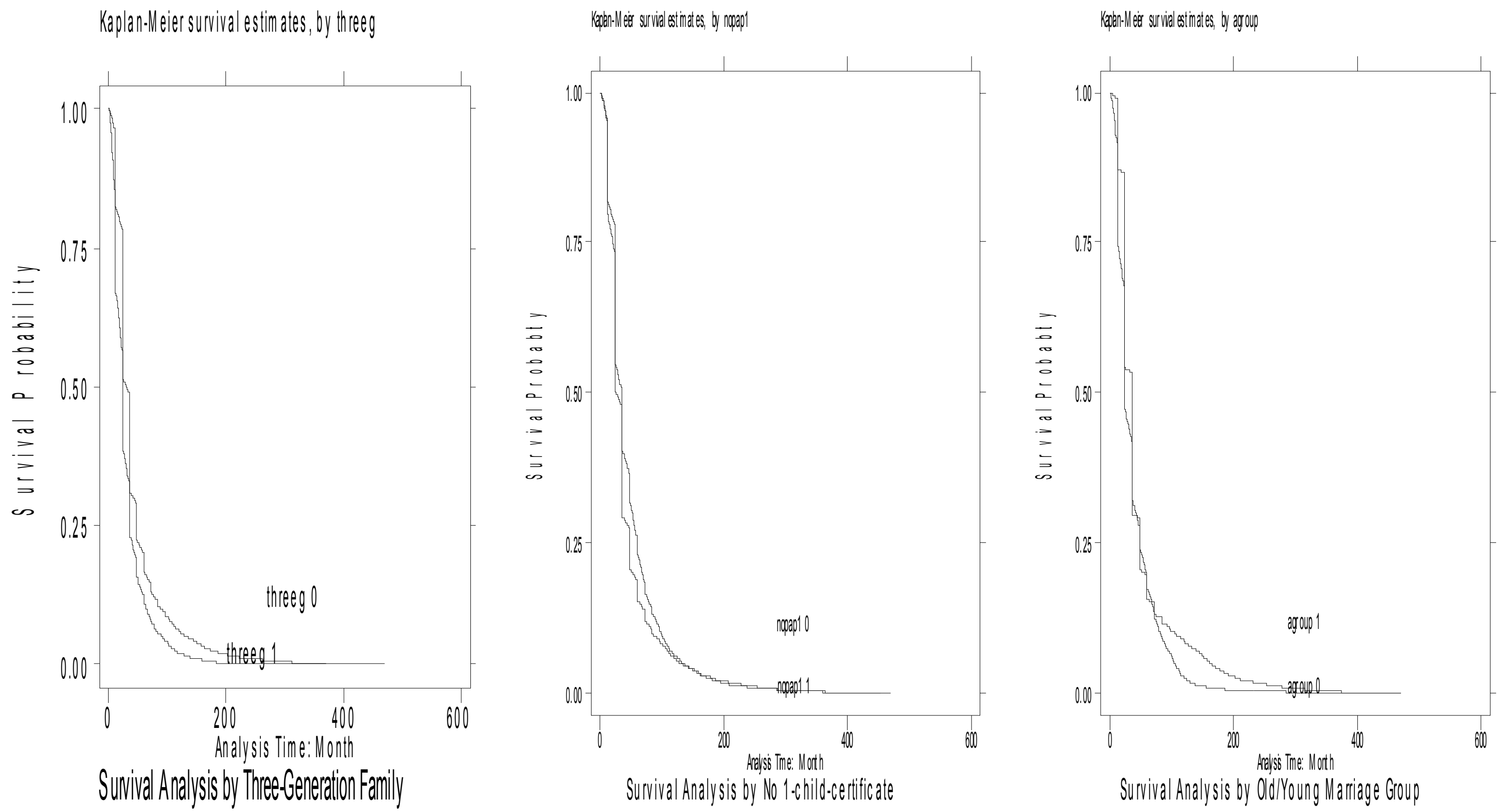


Figure 6.9 (Continued)



Source: SFPCC 1989

Figure 6.9 (Continued)

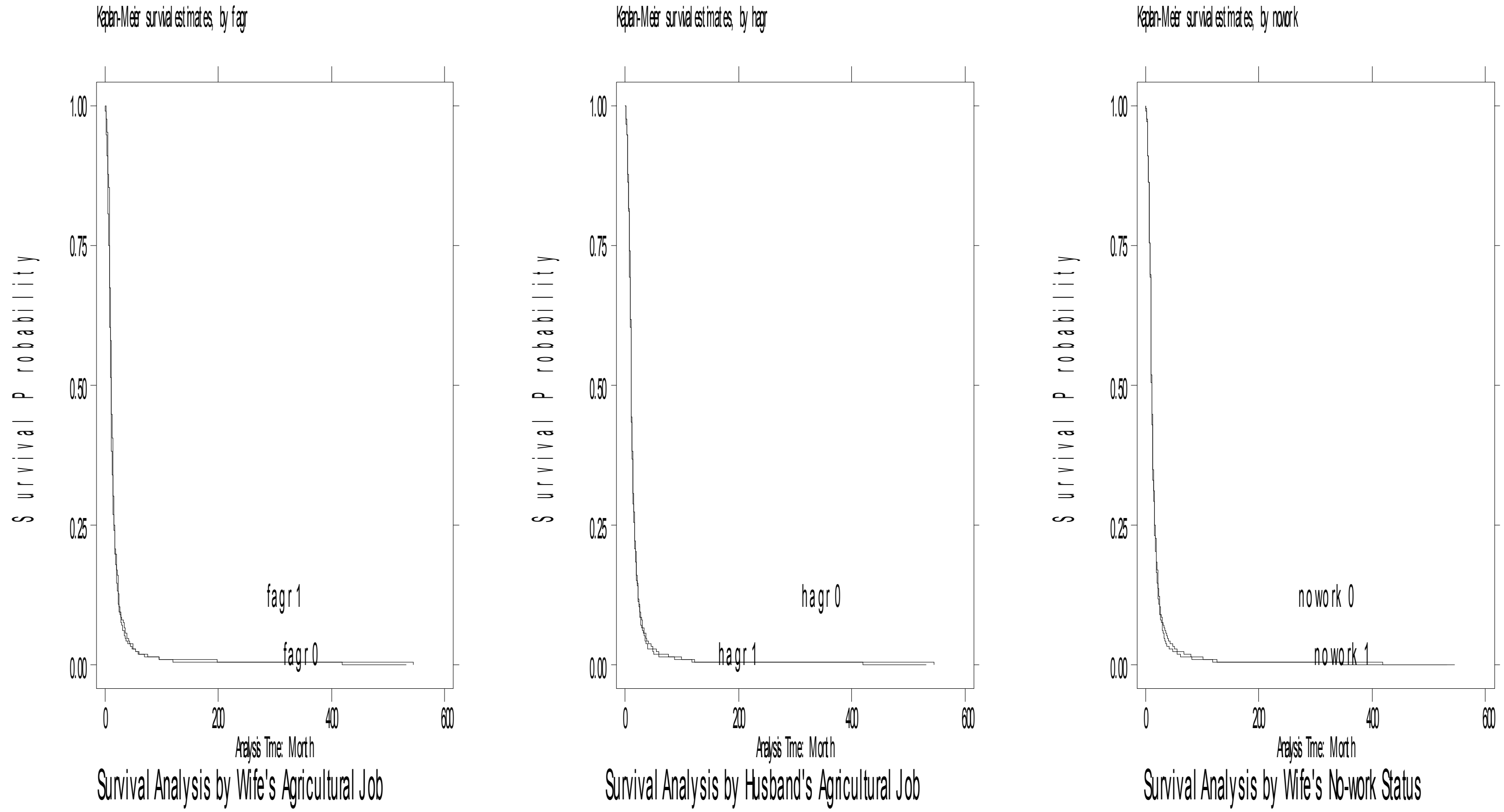
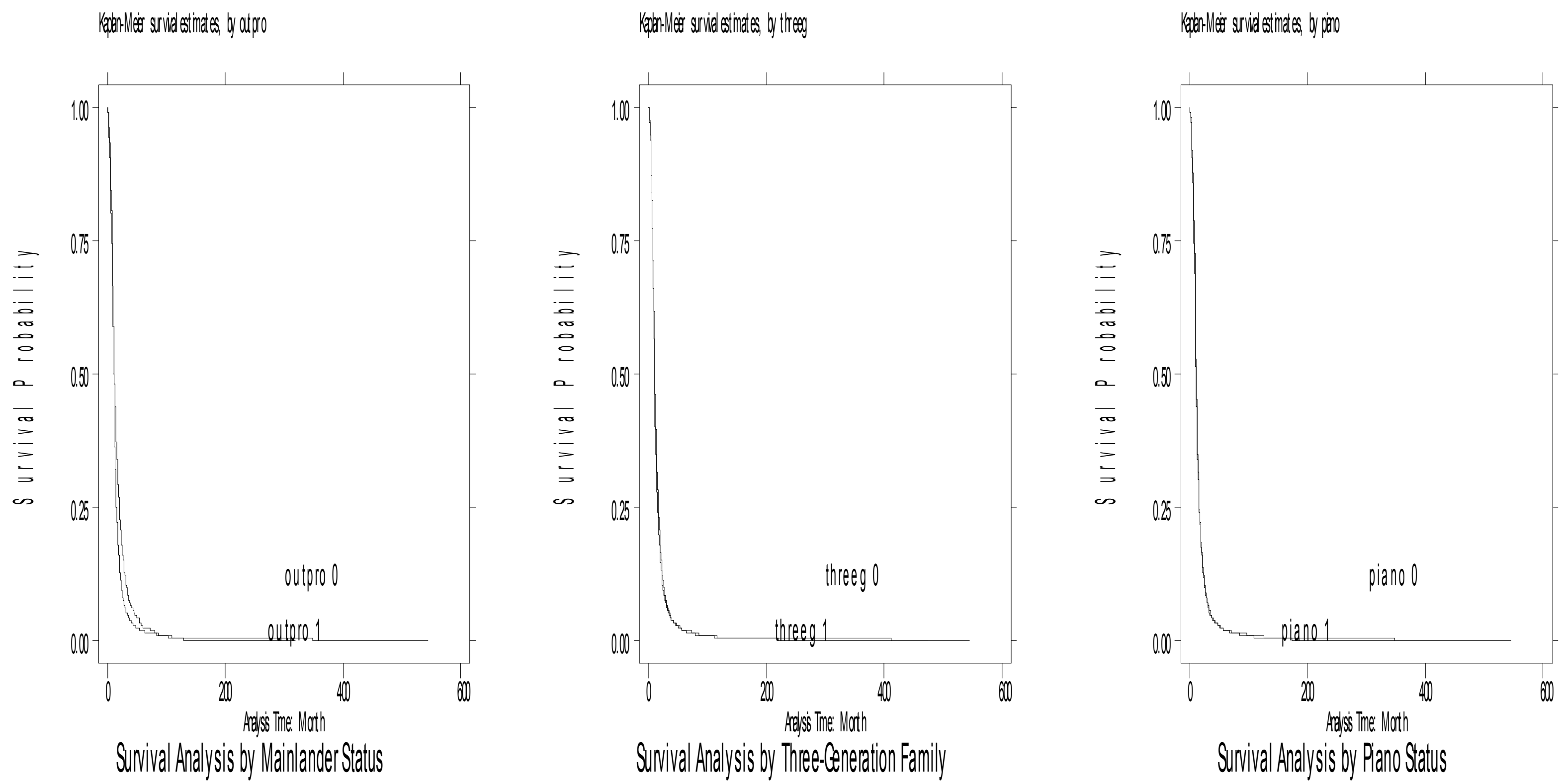


Figure 6.10 Probability of Surviving the Hazard of Having the First Childbirth in 1992 Taiwan Data, Stratified by Dichotomous Predictors



Source: TPIFP 1992

Figure 6.10 (Continued)

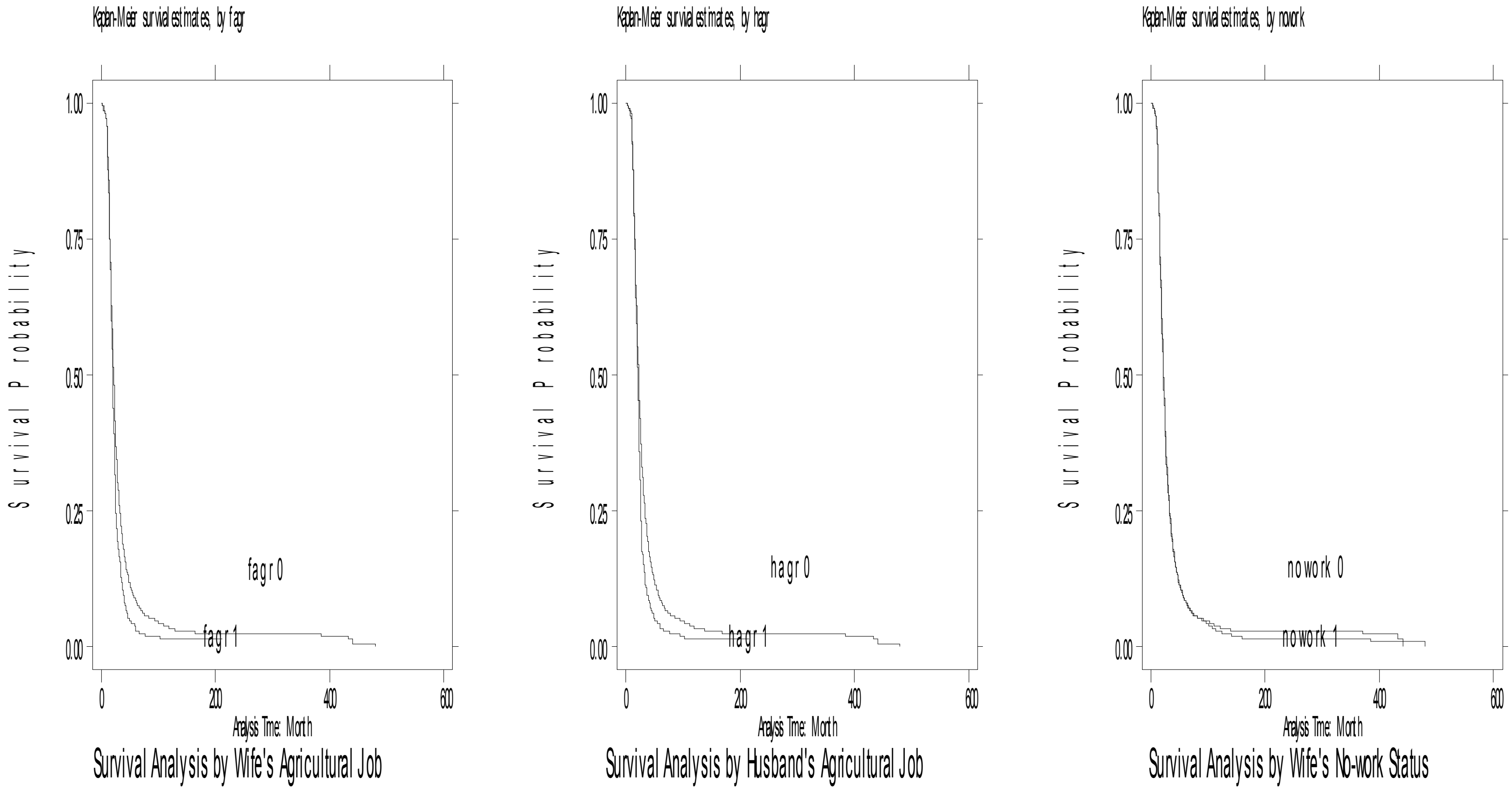


Figure 6.11 Probability of Surviving the Hazard of Having the Second Childbirth in 1992 Taiwan Data, Stratified by Dichotomous Predictors

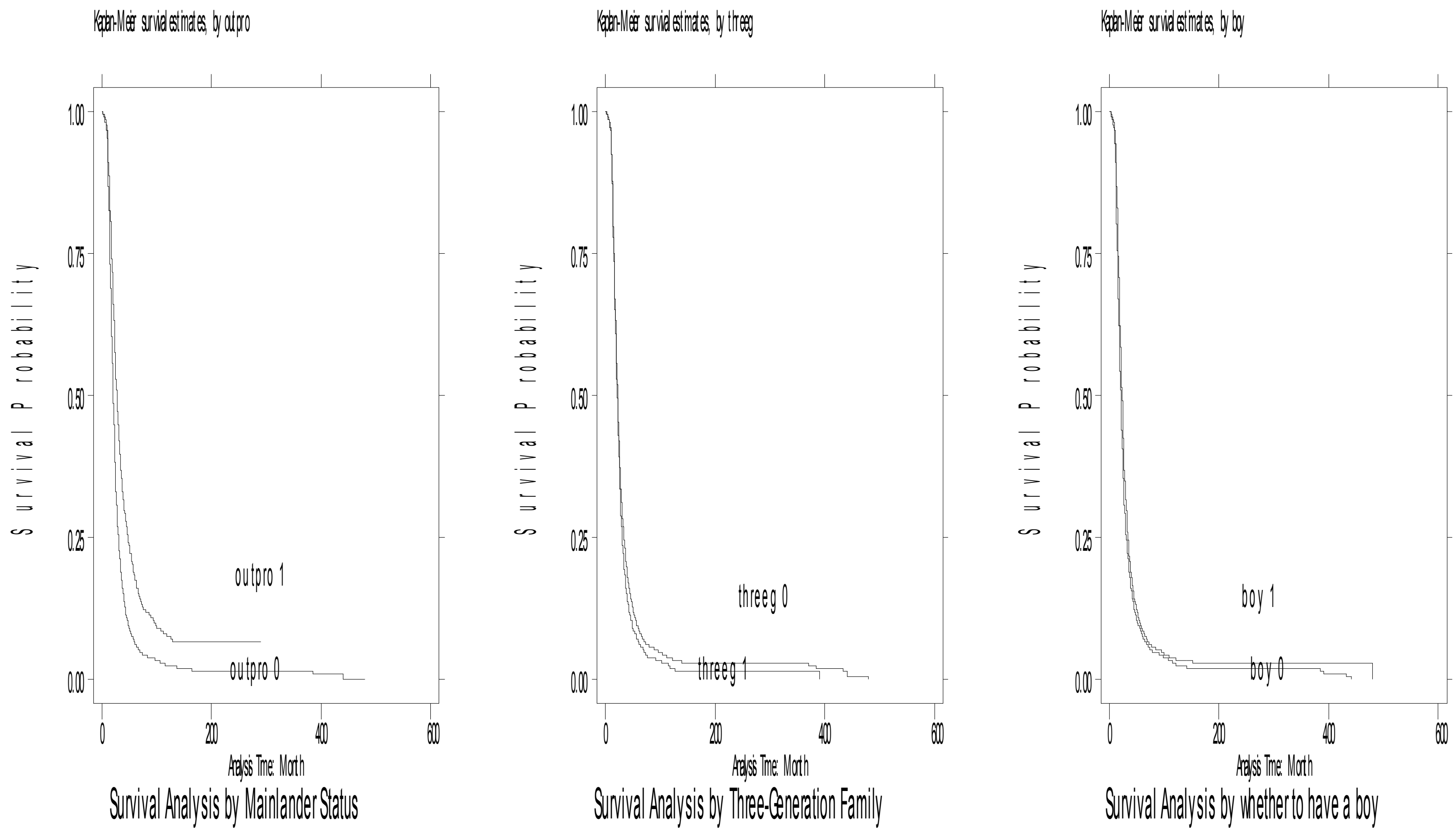
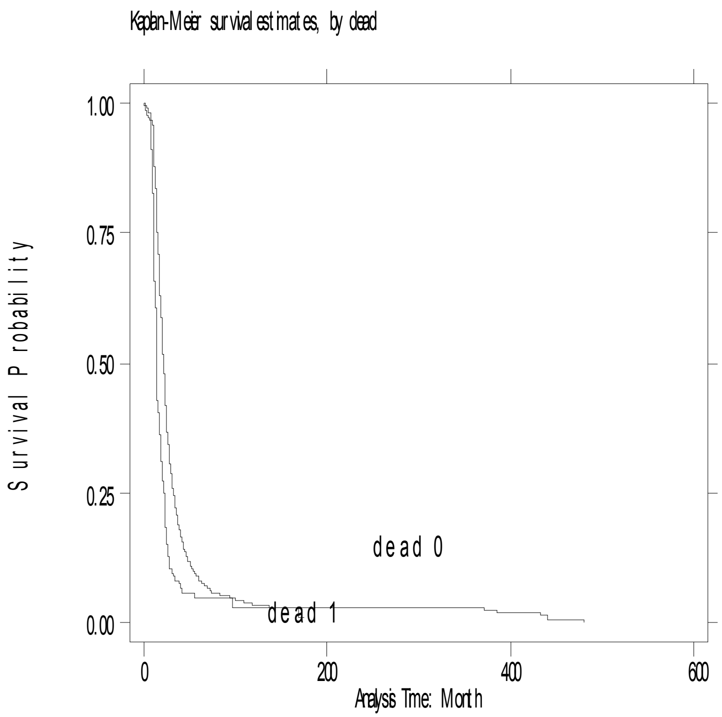
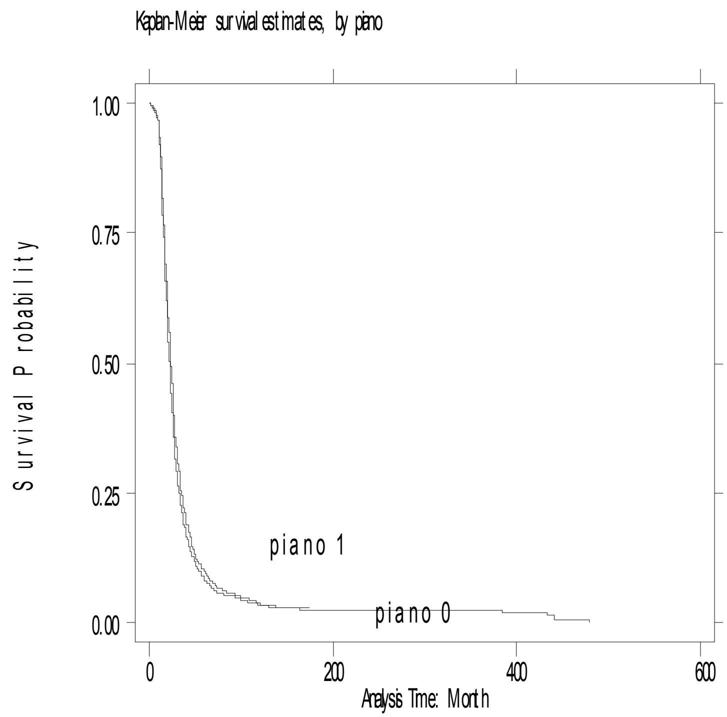


Figure 6.11 (Continued)



Survival Analysis by whether to have dead child



Survival Analysis by Piano Status

Source: TPIFP 1992

Figure 6.11 (Continued)

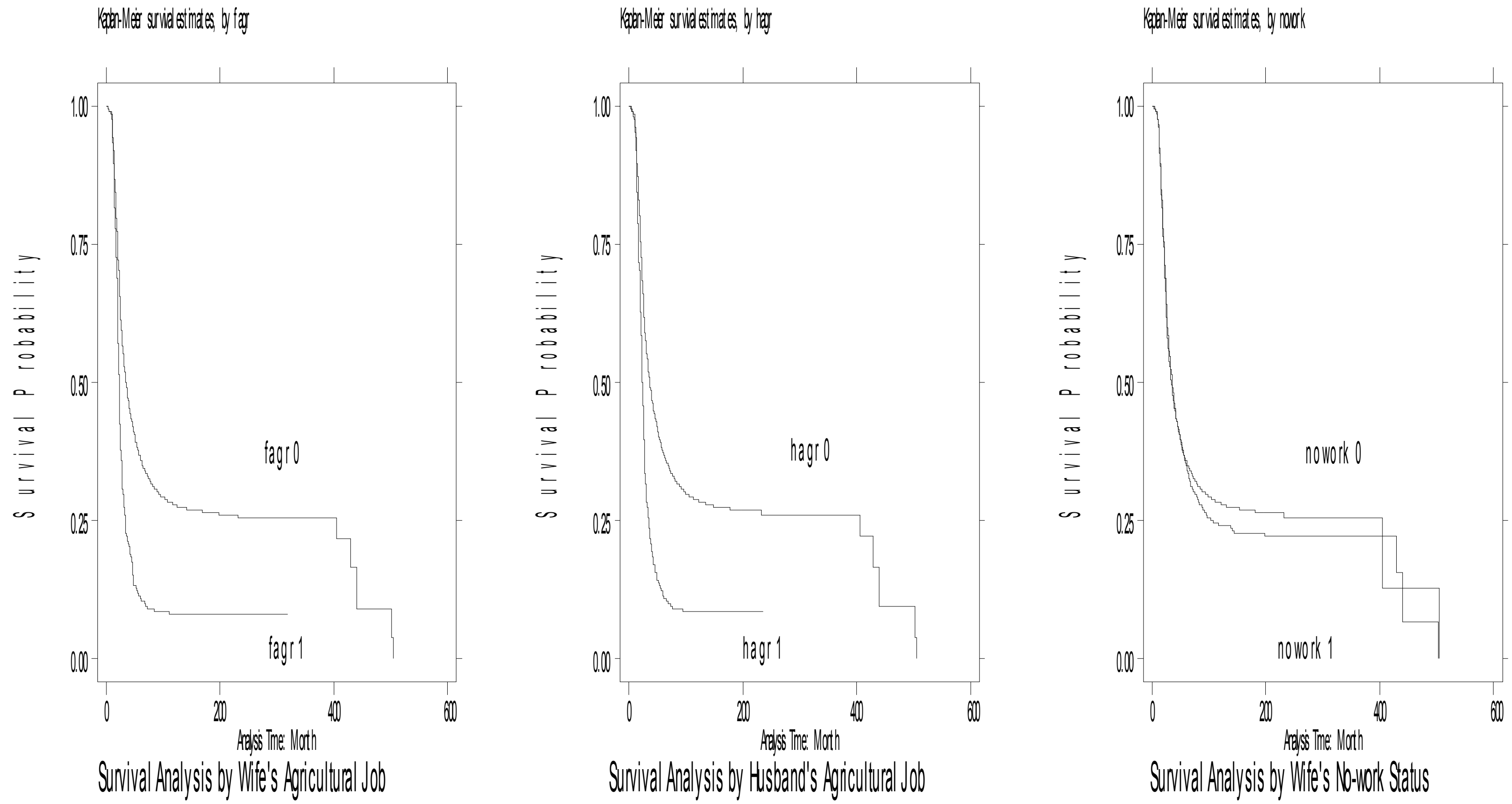


Figure 6.12 Probability of Surviving the Hazard of Having the Third Childbirth in 1992 Taiwan Data, Stratified by Dichotomous Predictors

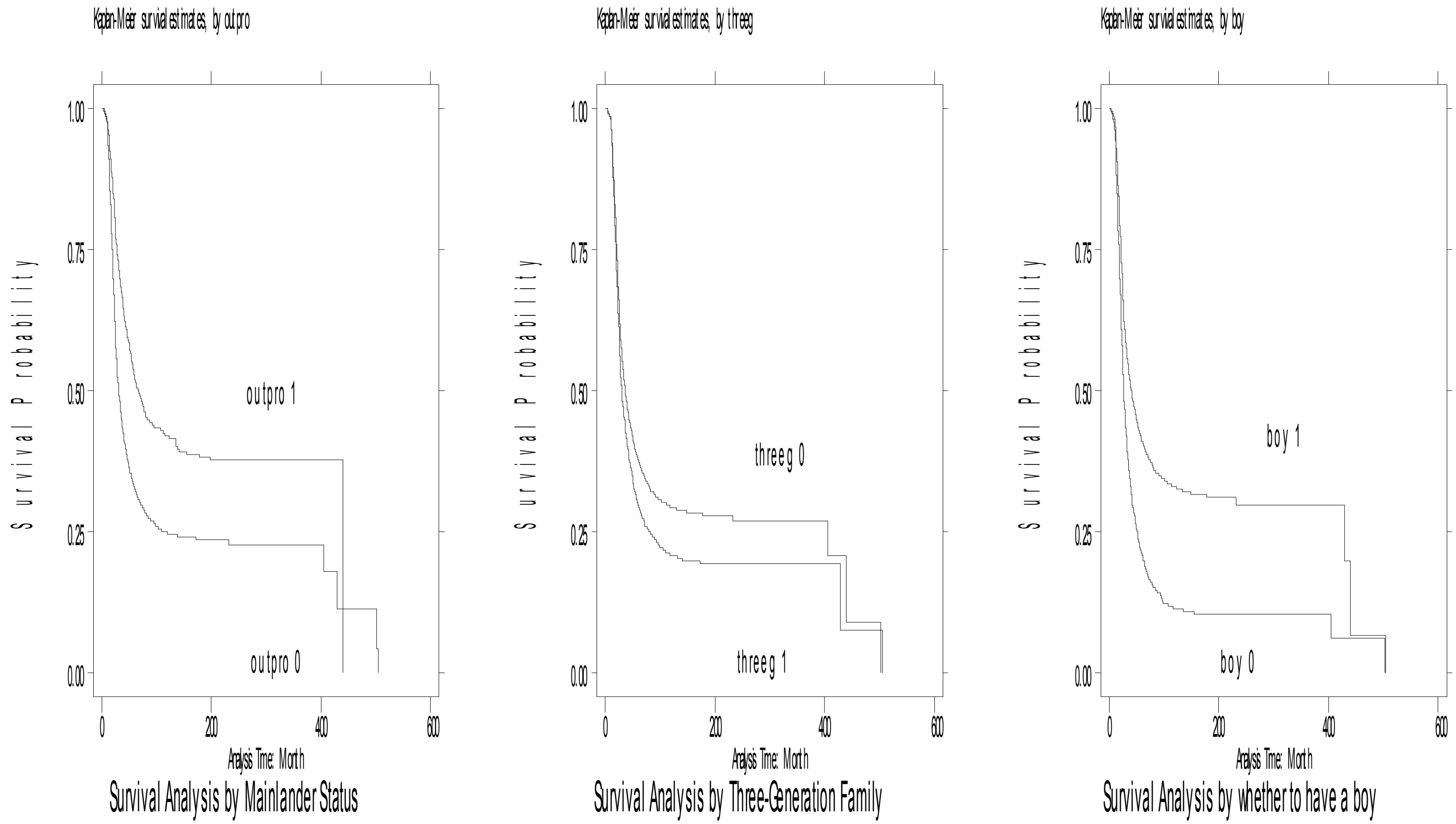
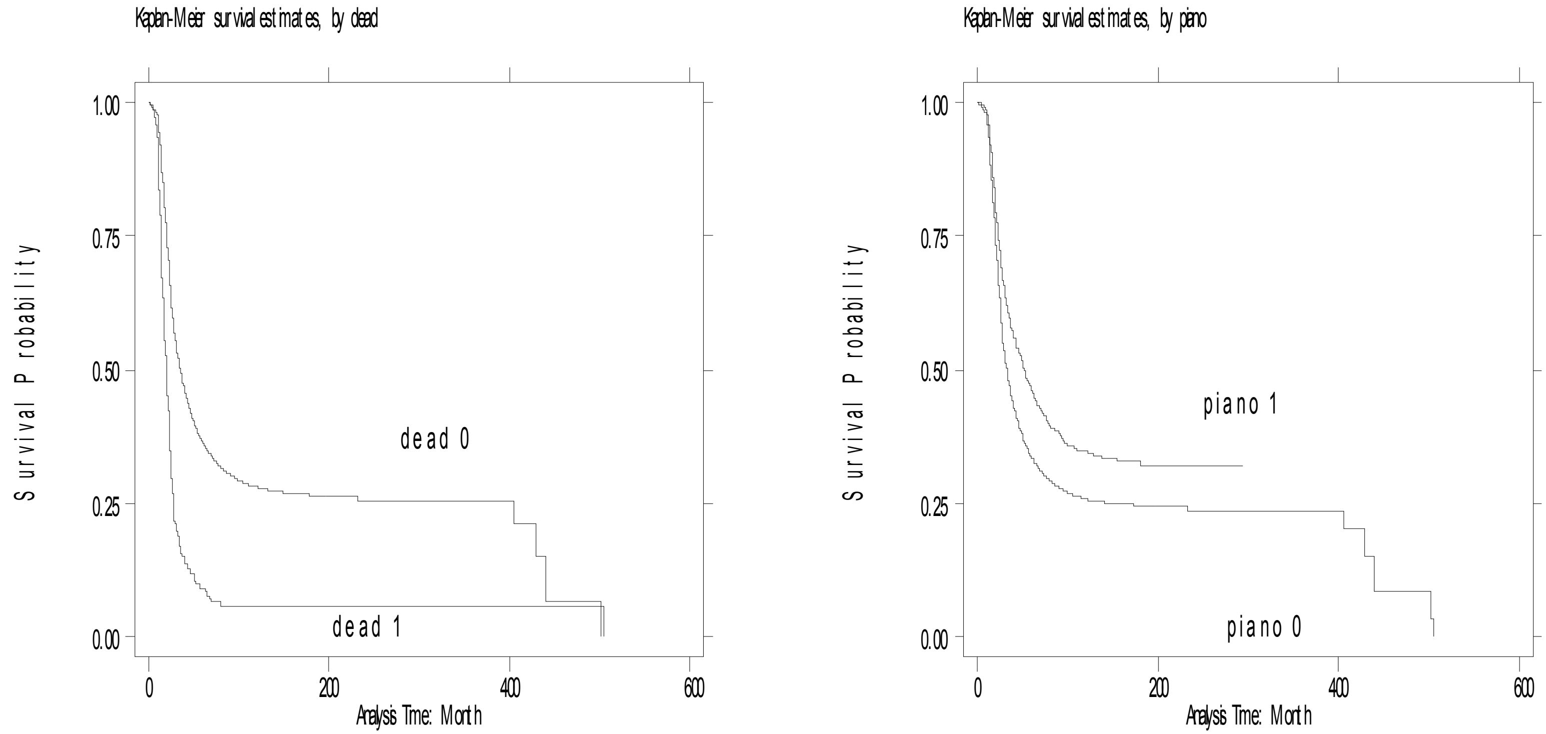


Figure 6.12 (Continued)



Survival Analysis by whether to have dead child

Survival Analysis by Piano Status

Source: TPIFP 1992

Figure 6.12 (Continued)

Multi-level Analysis

One-way ANOVA Model

As mentioned in Chapter V, within the structure of a typical two-level hierarchical linear model, analysis starts with estimating a one-way ANOVA model (fully unconditionedmodel) before proceeding to multi-level analysis. The one-way ANOVA model partitions the variance in the outcome variable across individual and aggregate levels by providing the intra-class correlation and displaying whether a multi-level analysis is proper (Bryk and Raudenbush 1992). However, Bryk and Raudenbush (1992) warn that the intra-class correlation—the ratio of level-2 variance to the total variation--is less informative in the case of nonlinear link functions, because the level-1 variance is now heteroscedastic. Snijders and Brsker (1999) and Long (1997) write that a substitute way to calculate an intra-class correlation for a nonlinear multilevel Model is to consider the level-1 model and its dependent variable in terms of a latent variable and compute the intra-class correlation by the formula

$\rho=\tau 00/ (\tau 00+\pi^2/3)$

in which τ00 is the level-2 variance component and level-1 variance component is the constant π2/3. Table 6.10 shows the one-way ANOVA models for the Poisson and Bernoulli non-linear multilevel models with China and Taiwan data, without any independent variables included. For these twenty Hierarchical Generalized Linear Models, the variability in the possibility of having the number of children ever born and being sterilized (in a province for China, and in a county for Taiwan) ranges

Table 6.10: One-way ANOVA Model for Poisson and Bernoulli Non-linear Multilevel Models with China and Taiwan Data.

Models	τ_{00}	P-value	$(\tau_{00}+\pi^2/3)$	$\tau_{00}/(\tau_{00}+\pi^2/3)$
Poisson--Children Ever Born				
China_All	0.04021	0.000	3.33007	1.21%
China_marital years<14yrs	0.05823	0.000	3.34809	1.74%
China_Rural	0.03783	0.000	3.32769	1.14%
Taiwan_All	0.00681	0.000	3.29667	0.21%
Taiwan_35yrs younger	0.00806	0.000	3.29792	0.24%
Bernoulli--Sterilization Status				
China_All	0.50651	0.000	3.79637	13.34%
China_marital years<14yrs	0.60509	0.000	3.89495	15.54%
China_Rural	0.53889	0.000	3.82875	14.07%
Taiwan_All	0.08127	0.000	3.37113	2.41%
Taiwan_35yrs younger	0.11585	0.000	3.40571	3.40%
Bernoulli--Wife Sterilization Status				
China_All	0.55136	0.000	3.84122	14.35%
China_marital years<14yrs	0.67895	0.000	3.96881	17.11%
China_Rural	0.61249	0.000	3.90235	15.70%
Taiwan_All	0.09252	0.000	3.38238	2.74%
Taiwan_35yrs younger	0.13317	0.000	3.42303	3.89%
Bernoulli--Husband Sterilization Status				
China_All	2.60531	0.000	5.89517	44.19%
China_marital years<14yrs	2.48233	0.000	5.77219	43.00%
China_Rural	3.251	0.000	6.54086	49.70%
Taiwan_All	0.09252	0.000	3.38238	2.74%
Taiwan_35yrs younger	0.13317	0.000	3.42303	3.89%

Source: TPIFP 1992, EYRC 1992, SFPCC 1989 and NBSC 1991

from 0.21% to 49%. Three sterilization status models in China have the bigger portion of the variance between provinces, especially, in the male sterilization models in China, which hints that the contextual variables play more important roles in influencing male sterilization decisions. All X^2 tests are values highly implausible ($p<0.0001$) under the null hypotheses. It can be concluded that there is significant variation among provinces and counties in women's fertility; hence, a province/county level variance is worthy of studying using HGLM methods.

Multi-level Models

From Table 6.11 to Table 6.15, I present HGLM analysis results for three groups of 1988 China data and two groups of 1992 Taiwan data. The rationale is to see whether there is any analysis dissimilarity due to the different demographic base. On the basis of the literature review and the previous analyses reported in this chapter, I first use the whole sample of 1988 China Fertility data with 30013 cases, as shown in Table 6.11. Women having marital years less than fourteen years from 1988 data, who should suffer the brunt of China's fertility policy from mid-1970, are a subset with 16470 cases in Table 6.12. So, I also take out the variable of marital years more than 14. Table 6.13 has 24461 cases for Chinese women living in rural areas, so the rural variable is not entered in the models. In Table 6.14, 11253 cases are for the whole 1992 KAP Taiwan data. Nevertheless, 6396 cases of ages younger than 35 years old are split from 1992 data in Table 6.15. Grouped together in Model I are wife's education and wife's agricultural occupation. Placed together in Model II are husband's education and husband's agricultural occupation.

Table 6.11 Multilevel Analyses: Effects (Gamma Coefficients) of Individual and Provincial Characteristics on the Likelihood of Number of Children Ever Born and Being Sterilized: 1988 China Data.

China All		Children Ever Born		Sterilization Status		Wife Sterilization Status		Husband Sterilization Status	
Effect	Index	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
For INTRCPT1									
INTRCPT2	G00	0.903 *	0.903 *	-0.733 *	-0.737 *	-0.960 *	-1.260 *	-1.835 *	-1.038 *
Female Occup. Partici. R.	G01	-0.370	-0.368	-0.679	-0.663	-2.825	-4.140	2.229	2.929 *
0-year-old Mortality R.	G02	7.942 *	7.936 *	-6.980	-6.950	-8.138	-11.525	0.687	-3.724
Total Fertility R.	G03	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G04	-13.076	-12.915	11.031	11.219	17.583	21.346	-9.908	-21.946
Female College Grad. R.	G05	2.067	2.101	-	-21.205	-12.127	-13.673	-8.857	-9.889
One-Child Certificate R.	G06	-2.183 *	-2.196 *	-4.228	-4.204	-6.071	-9.329	1.609	1.064
For Living in Rural Area		B1	B1	B1	B1	B1	B1	B1	B1
INTRCPT2	G10	0.112 *	0.139 *	0.014	0.237 *	0.056	0.211 *	0.024	-0.026
Female Occup. Partici. R.	G11	-0.274	0.128	-2.165	-1.839	-1.434	-2.618	-0.504	0.040
0-year-old Mortality R.	G12	3.153	2.289	9.137	17.403	5.322	16.176	4.134	6.195
Total Fertility R.	G13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G14	-15.975	-7.045	-	-21.097	-20.572	-7.202	-7.756	-12.510
Female College Grad. R.	G15	3.872	4.710	2.444	5.670	0.232	6.128	1.363	-6.678
One-Child Certificate R.	G16	-0.478	-1.031	0.177	-0.332	0.751	-0.539	-0.261	0.512
For Married More than 14 years		B2	B2	B2	B2	B2	B2	B2	B2
INTRCPT2	G20	0.055 *	0.058 *	0.199 *	0.205 *	0.211 *	0.237 *	-0.011	-0.009
Female Occup. Partici. R.	G21	-0.156	-0.134	1.177	1.124	1.005	1.563	0.488	0.058
0-year-old Mortality R.	G22	-0.645	-0.936	7.113	7.567	1.600	3.438	4.818	4.481
Total Fertility R.	G23	0.000	0.000	-0.000 *	-0.000 *	-0.000 *	-0.000 *	-0.000	-0.000
Female Divorce R.	G24	-0.111	2.396	5.093	3.676	21.028	30.535	-10.201	2.084
Female College Grad. R.	G25	-1.767	-1.782	-9.450	-8.463	-6.954	-7.983	-4.349	-9.372
One-Child Certificate R.	G26	0.546	0.379	2.121	1.550	0.111	-0.999	2.288	3.099
For Wife's Education		B3		B3		B3		B3	
INTRCPT2	G30	-0.022 *		-0.029		-0.029		-0.011	
Female Occup. Partici. R.	G31	0.042		-0.135		0.087		-0.177	
0-year-old Mortality R.	G32	-0.409		1.765		1.038		0.737	
Total Fertility R.	G33	0.000		0.000		0.000		0.000	
Female Divorce R.	G34	0.438		-8.641		-5.990		-3.804	
Female College Grad. R.	G35	-1.459 *		-0.264		-0.171		-0.650	
One-Child Certificate R.	G36	0.019		0.177		0.291		-0.046	
For Husband's Education			B3		B3		B3		B3
INTRCPT2	G30		-0.023 *		0.028		0.022		0.006
Female Occup. Partici. R.	G31		0.022		-0.174		0.025		-0.104
0-year-old Mortality R.	G32		-0.070		1.275		1.395		0.350
Total Fertility R.	G33		0.000		0.000		0.000		0.000
Female Divorce R.	G34		0.102		-7.492		-3.443		-9.964
Female College Grad. R.	G35		-0.915		2.337		1.866		1.139
One-Child Certificate R.	G36		-0.103		-0.381		-0.034		-0.243
For HAN Status		B4	B4	B4	B4	B4	B4	B4	B4
INTRCPT2	G40	-0.008 *	-0.007 *	0.350 *	0.328 *	0.274 *	0.334 *	0.200	0.111
Female Occup. Partici. R.	G41	0.393	0.392	-1.886	-2.371	-2.013	-2.780	-0.619	-0.393
0-year-old Mortality R.	G42	4.310	4.429	5.179	8.730	7.923	14.639	-3.995	-3.010
Total Fertility R.	G43	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G44	-22.440 *	-21.163 *	45.223	44.516	41.208	41.720	20.420	28.254
Female College Grad. R.	G45	-1.414	-2.370	-	-12.105	-9.265	-16.284	-2.705	-6.084
One-Child Certificate R.	G46	3.816 *	4.018 *	4.099	4.952	3.908	10.389	0.056	0.913

Table 6.11 (Continued)

China All		Children Ever Born		Sterilization Status		Wife Sterilization Status		Husband Sterilization Status	
Effect	Index	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
For Wife's Age		B5	B5	B5	B5	B5	B5	B5	B5
INTRCPT2	G50	0.027 *	0.027	-0.016 *	-0.015 *	-0.019 *	-0.024 *	0.002	0.005
Female Occup. Partici.	G51	0.040	0.037	0.023	0.030	0.036	0.052	-0.025	-0.022
0-year-old Mortality R.	G52	-0.379 *	-0.354 *	-0.164	-0.184	0.075	-0.029	-0.214	-0.260
Total Fertility R.	G53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G54	0.968	0.849	-0.265	-0.342	-1.220	-1.563	0.891	1.451
Female College Grad.	G55	-0.110	-0.079	0.106	0.011	0.117	-0.025	-0.018	0.183
One-Child Certificate R.	G56	0.005	0.017	0.033	0.098	0.091	0.147	-0.068	-0.106
For 3-Generation		B6	B6	B6	B6	B6	B6	B6	6.000
INTRCPT2	G60	-0.385 *	-0.381 *	-0.719 *	-0.755 *	-0.614 *	-1.092 *	-0.050	-0.231
Female Occup. Partici.	G61	0.336	0.352	0.416	0.246	1.981	1.555	-1.574	-1.538
0-year-old Mortality R.	G62	-4.935	-5.595	2.968	4.401	4.561	2.726	-0.821	-1.586
Total Fertility R.	G63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G64	31.189 *	37.825 *	-17.199	-26.951	-25.986	-56.269	12.722	-18.923
Female College Grad.	G65	-0.234	-0.955	12.636	12.066	8.834	11.214	3.893	8.939
One-Child Certificate R.	G66	0.662	0.581	1.218	1.825	2.114	-0.061	-0.564	-0.051
For Number of Dead				B7	B7	B7	B7	B7	B7
INTRCPT2	G70			-0.383 *	-0.381 *	-0.360 *	-0.404 *	-0.043	-0.046
Female Occup. Partici.	G71			0.404	0.371	0.470	0.353	-0.325	-0.015
o-year-old Mortality R.	G72			2.460	2.921	3.673	4.420	-1.358	-0.404
Total Fertility R.	G73			0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G74			6.397	2.867	-6.704	-10.469	13.814	13.930
Female College Grad.	G75			2.750	2.863	1.926	1.518	1.415	-0.915
One-Child Certificate	G76			0.272	0.356	0.578	0.616	-0.600	-0.003
For Wife's Agri. Occup.		B7		B8		B8		B8	
INTRCPT2	G80	0.077 *		0.274 *		0.181		0.152	
Female Occup. Partici.	G81	0.459		-0.464		-0.927		0.425	
0-year-old Mortality R.	G82	-0.448		5.567		1.923		3.143	
Total Fertility R.	G83	0.000		0.000		0.000		0.000	
Female Divorce R.	G84	8.417		16.939		26.618		-3.160	
Female College Grad.	G85	1.383		-5.902		-2.025		-3.812	
One-Child Certificate R.	G86	-0.542		1.420		-0.112		1.295	
For Husband's Agri.			B7		B8		B8		
INTRCPT2	G80		0.057 *		0.076		0.043		-0.006
Female Occup. Partici.	G81		-0.141		-0.971		-1.487		-0.420
0-year-old Mortality R.	G82		2.239		-1.773		-3.157		1.900
Total Fertility R.	G83		0.000		0.000		0.000		0.000
Female Divorce R.	G84		-8.940		3.037		4.587		-0.224
Female College Grad.	G85		1.866		-7.984		-7.662		-9.255
One-Child Certificate R.	G86		0.283		2.697		1.636		2.448
For No One-child		B8	B8	B9	B9	B9	B9	B9	
INTRCPT2	G90	0.257 *	0.261 *	0.644 *	0.714 *	0.537 *	0.880 *	0.319	0.127
Female Occup. Partici.	G91	0.232	0.295	2.014	2.273	0.430	1.441	1.024	1.696
0-year-old Mortality R.	G92	-1.713	-1.975	-21.552	-25.496 *	-18.478	-31.151 *	-3.414	-4.580
Total Fertility R.	G93	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G94	-6.677	-5.891	44.952	60.969	36.316	71.195	17.961	5.644
Female College Grad.	G95	-2.346	-1.790	-13.827	-13.662	-8.042	-8.045	-4.382	-5.293
One-Child Certificate R.	G96	0.976	0.819	-0.204	-1.141	-1.059	-1.335	-0.763	1.459
Female Divorce R.	G104			3.915	9.024	7.227	11.965	-5.550	-3.588

Table 6.11 (Continued)

China All Effect	Index	Children Ever Born Model I	Children Ever Born Model II	Sterilization Status Model I	Sterilization Status Model II	Wife Sterilization Status Model I	Wife Sterilization Status Model II	Husband Sterilization Status Model I	Husband Sterilization Status Model II
For Number of Boys				B10	B10	B10	B10	B10	B10
INTRCPT2	G100			0.259 *	0.264 *	0.216 *	0.267 *	0.049	0.053 *
Female Occup. Partici. R.	G101			0.131	0.184	-0.147	-0.020	0.351	-0.023
o-year-old Mortality R.	G102			-0.637	-1.304	-1.711	-2.375	1.221	0.733
Total Fertility R.	G103			0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G104			3.915	9.024	7.227	11.965	-5.550	-3.588
Female College Grad. R.	G105			-0.599	0.196	1.271	3.102	-1.959	0.837
One-Child Certificate R.	G106			0.446	0.117	-0.389	-0.560	0.879	0.256
For Childbirth with Quota		B9	B9	B11	B11	B11	B11	B11	11.000
INTRCPT2	G110	-0.347 *	-0.345 *	-0.759 *	-0.772 *	-0.678 *	-1.098 *	-0.086	-0.151 *
Female Occup. Partici. R.	G111	1.188	1.194	1.900	1.954	2.733	2.576	-0.966	-0.133
0-year-old Mortality R.	G112	-10.870 *	-10.940 *	-5.944	-7.191	-2.281	-11.758	-3.976	-4.721
Total Fertility R.	G113	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G114	14.245	15.011	-22.709	-14.989	-33.630	-26.330	12.472	11.108
Female College Grad. R.	G115	-0.658	-1.223	16.465	15.371	14.743	17.201	2.234	-2.279
One-Child Certificate R.	G116	0.579	0.693	-3.857	-3.902	-3.463	-9.870 *	-0.757	-0.412

Note: * $p<.05$

Source: SFPCC 1989 and NBSC 1991

Table 6.11

To begin with, let's look at Table 6.11. Because I center the independent variables in the individual-level equations about their corresponding provincial or county means, so their new means are zero (Arnold 1992; Bryk and Raudenbush 1992). This makes the intercepts(G_{00} or γ_{00}) in the HGLM models the grand mean of the log of the number of children ever born, or log odds of being sterilized, for Chinese married women with values of zero on all the predictors. By way of illustration, consider Chinese non-Han women living in rural area and married less than 14 years, have zero schooling (as does her husband), is 16 years of age, has non-three-generation familial structure status, non-agricultural occupation status (as does her husband), one-child certificates, and no experience of childbirth within quota. The γ_{00} coefficient for the CEB Model I in is 0.903. For sterilization models, the γ_{00} coefficient is -0.733 in Model I. We can convert it into a "predicted probability" using this formula,

1 / (1+ exp {- predicted log-odds coefficient})

The probability of being sterilized for Chinese married women or her husbands with average values on all the predictors is .32. For wife's sterilization status, the coefficient in Model I is -0.96, so the probability for wives being sterilized is 28%. The coefficient in Model I for husband's sterilization is -1.835, so the probability for wives' husbands being sterilized is 14%.

The G_{01}(γ_{01}) coefficient through the coefficient G06(γ_{06}) are the main effects of the level-2, contextual variables on the dependent variables. In CEB models, 0-year-old mortality rate (G02) and one-child certificate rate (G06) passed the significance test. The higher the percentage of 0-year-old mortality rate in a province, the higher a province's average expected log of women's CEB. The association agrees with the proffered hypothesis. The lower the percentage of one-child certificate rate in a province, the higher a province's average expected log of women's CEB. This is in agreement with the hypothesis, as well. In husband's sterilization Model II, Female Occupation Participation Rate is significant. That means that the higher the percentage of Female Occupation Participation Rate in a province, the higher a province's average expected log odds of husband's sterilization. We can say this represents a consequence of a rise in women's status.

G10, G20 to G110 are the main effects of the level-1 variables on the dependent variables. For CEB models in Table 6.11, all individual-level variables pass the significance test, the same as in Table 6.4 for the individual-level Poisson analysis. Even the relationships of association of coefficients with CEB are identical to the individual-level Poisson analysis. Three-Generation Familial Structure still acts negatively on CEB, which is against the hypothesis.

The γ_{10} coefficient is 0.112, i.e., odds ratio= $e^{0.112}$ =1.19. This is the main effect of rural status on the log of children ever born. So we could say that in comparing two women with a difference of rural status, the rural woman is predicted to have 19% more children ever born than the non-rural woman, controlling for the other variables. Regarding the two main indices of women's status, the γ_{30} odds ratio of wife's educational level is 0.98, i.e., $e^{-0.022}$. Comparing two women with a difference of one year in schooling, the woman with more schooling is predicted to have 2% fewer children ever born than the other woman. The γ_{80} odds ratio of Wife's Agricultural Occupation is 1.08, so, after controlling for the other variables, farming women will have 8% more CEB than non-farming women. Concerning the two policy variables, the γ_{90} odds ratio of No One-child Certificate is 1.29; that is, after controlling other variables, women who have not accepted a One-child Certificate will have 29% more CEB than those with the certificate. The γ_{110} odds ratio of Experience of Childbirth with Quota is 0.71; hence, after controlling other variables, women with Experience of Childbirth with Quota will have 29% fewer CEB than those without.

For G10, G20 to G110 of three sterilization status models, all of them for male sterilization models fail to pass the significance tests, except for Number of Boys and Experience of Childbirth with Quota. Surprisingly, wife's or husband's educational level does not pass the significance test in these three kinds of models. Regarding Agricultural Occupation status, only wife's Agricultural Occupation status (γ_{80}) in sterilization status model is statistically significant. The coefficient is 0.274. It means that the farming wife would have log odds of having herself or her husband be sterilized that are 0.274 higher than the non-farming wife. The odds ratio of Wife's Agricultural Occupation is 1.32; so, after controlling for the other variables, farming women will have 32% higher probability of the couple's being sterilized than non-farming women. Women's status does not play an impressive role in these sterilization models. However, the two policy variables have a better showing.

As in the logistic analysis, where I discuss why the two policy variables of the one-child certificate and experience of childbirth within quota show results contrary to the hypothesis that they increase sterilization rate, such unexpected results are again observed in Table 6.11. The γ_{90} odds ratio of No One-child Certificate in wife Sterilization Model Is 1.71 (exponentiating the coefficient 0.537); that is, after controlling for the other variables, women who have not accepted a One-child Certificate are 71% more likely to be sterilized than those who have. The γ_{110} odds ratio of Experience of Childbirth with Quota in Model II of male sterilization models is significant at 0.86 after exponentiating the coefficient -0.151; therefore, after controlling for the other variables, women with experience in childbirth with quota will have 29% less probability of having their husbands than those without.

The rest of the coefficients represent the cross-level interactions involving the level-2 variables on the slopes of the individual variables on fertility. As I have pointed out in previous chapters, a distinctive contribution of this dissertation that is not found in other studies is the estimation of cross-level interaction effects. However, overall, there are not many interaction coefficients passing the significance tests. In CEB models, the γ_{35} coefficient is -1.459, which does reach the significant level. This is the cross-level interaction involving the Female College Graduation Rate of level-2 variable on the slope of wife's educational level on CEB. Were it significant, it would suggest that for every increase of 1% in Female College Graduation Rate in a province, the slope of wife's educational level on the log number of children ever born would be decreased by 1.459. That means that when women live in a province with higher women's educational attainment, the depressing effect of her schooling level on CEB will decease. This is against the hypothesis that Female College Graduation Rate will help decrease women's number of CEB.

The γ_{44} coefficient is -22.44. This interaction engages the Female Divorce Rate aggregate variable on the slope of Han status on CEB. It indicates that for every increase of 1% Female Divorce Rate in a province, the slope of Han's status on the log number of CEB would decrease by 22.44. It denotes that Han women have less depressing effect of her Han status on the number of CEB in a province where there is a stronger trend to end marriage by divorce. It is against the hypothesis. Also on Han status, One-Child

Certificate Rate has a positive cross-level effect on the slope of Han status on CEB. Understandably, the Han status of Chinese women has a greater depressing effect on CEB when they live in a province with more successful promotion of the One-Child Certificate.

On Three Generation Familial Structure, the γ_{64} coefficient of cross-level effect of Female Divorce Rate is 31.2. It connotes that the lowering effect of Three Generation Familial Structure on CEB will be stronger when a province has a higher divorce rate. This is against the hypothesis. The γ_{112} cross-level effect of 0-year-old Mortality Rate on the declining effect of Childbirth with Quota on CEB is negative; therefore, women participating in a local quota arrangement will be likely to have a higher number of CEB where her province has a higher 0-year-old Mortality Rate, which falls within the hypothetical expectation.

Regarding the cross-level effects in the sterilization status models, the γ_{23} of Total Fertility Rate of level-2 variable has a negative effect on the enhancing slope of marital years over 14 years on the probability of having women and her husbands being sterilized or having women themselves being sterilized. So when women of marital years over 14 years live in a province with a higher total fertility rate, they and their husbands, or they themselves, will have a lower sterilization rate than those also with marital years more than 14 years not living in provinces with higher total fertility rate. This is in agreement with the hypothesis because total fertility rate should have a negative relationship with sterilization status. The γ_{92} of 0-year-old Mortality Rate in husband's models significantly and negatively affects the enhancing effect of No One-child

Certificate on the sterilization status of women and their husbands as couples and as wives separately. It is comprehensible that in the provinces with a higher 0-year-old Mortality Rate, the contextual effect of needing more childbirth to counteract the higher infant mortality rate will retard the pro-sterilization trend. The γ_{116} of One-child Certificate Rate of provincial level significantly impairs the decreasing effect of experience of childbirth within quota on wife's sterilization. It is also logical that in the provinces with a higher One-child Certificate Rate, the contextual effect of abiding by the one-child policy appears to break the anti-sterilization trend, even though women might live in a local area with diverse alternative ways to control fertility.

Table 6.12

As mentioned before, in Table 6.12, I choose those marital years less than 14 years in 1988 China data. In this younger population, the γ_{00} coefficient for the CEB Model I is 1.92, and for Sterilization models, the γ_{00} coefficient is 0.269 in Model I and Model II. Using the same formula--**1 / (1+ exp {- predicted log-odds coefficient}),** we convert it into a "predicted probability." The probability of being sterilized for Chinese married women or her husbands with average values on all the predictors is .57, which was higher on the previous table. For wife's sterilization status, the coefficient in Model I is 0.23, so the probability for wives' being sterilized is 56%. The coefficient in Model I for husband's sterilization is 0.04, so the probability for wives' husbands' being sterilized is 51%.

Table 6.12 Multilevel Analyses: Effects (Gamma Coefficients) of Individual and Provincial Characteristics on the Likelihood of Number of Children Ever Born and Being Sterilized: 1988 China Data—Marital Years Less Than 14 Years.

China Marital Years Less Than 14		Children Ever Born		Sterilization Status		Wife Sterilization Status		Husband Sterilization Status	
Effect	Index	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
For INTRCPT1		B0	B0	B0	B0	B0	B0	B0	B0
INTRCPT2	G00	1.920 *	1.920 *	0.269 *	0.269 *	0.230 *	0.230 *	0.040 *	0.040 *
Female Occup. Partici. R.	G01	-1.064	-1.066	-0.352	-0.352	-0.678	-0.679	0.322	0.322
0-year-old Mortality R.	G02	19.065 *	19.171 *	-1.719	-1.703	-1.580	-1.569	-0.142	-0.135
Total Fertility R.	G03	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G04	-39.921 *	-40.255 *	-0.934	-0.968	0.463	0.449	-1.328	-1.371
Female College Grad. R.	G05	7.239	7.243	-3.131	-3.142	-1.958	-1.961	-1.152	-1.152
One-Child Certificate R.	G06	-3.927 *	-3.908 *	-1.222	-1.215	-1.299	-1.297	0.060	0.062
For Living in Rural Area		B1	B1	B1	B1	B1	B1	B1	B1
INTRCPT2	G10	0.059	0.134 *	0.019	0.049 *	0.015	0.029	0.004	0.019 *
Female Occup. Partici. R.	G11	1.161	1.856	-0.153	-0.202	-0.037	-0.176	0.002	0.036
0-year-old Mortality R.	G12	-0.923	-0.655	1.179	1.334	-0.161	-0.434	0.416	1.412
Total Fertility R.	G13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G14	-22.537	2.236	-1.126	2.522	0.335	6.594	0.329	-3.221
Female College Grad. R.	G15	3.777	7.019	0.269	0.350	0.379	0.208	-0.017	0.027
One-Child Certificate R.	G16	-1.892	-3.222	-0.024	-0.297	-0.167	-0.413	-0.019	0.098
For Wife's Education		B2		B2		B2		B2	
INTRCPT2	G20	-0.040 *		-0.012 *		-0.013 *		0.001	
Female Occup. Partici. R.	G21	0.245		0.059		0.100		-0.023	
0-year-old Mortality R.	G22	-1.681		0.264		0.062		0.121	
Total Fertility R.	G23	0.000		0.000		0.000		0.000	
Female Divorce R.	G24	-0.295		-1.244		-0.875		0.060	
Female College Grad. R.	G25	-2.460		-0.416		-0.246		-0.142	
One-Child Certificate R.	G26	0.205		0.071		0.035		0.018	
For Husband's Education			B2		B2		B2		B2
INTRCPT2	G20		-0.051 *		-0.007		-0.008		0.002
Female Occup. Partici. R.	G21		0.354		-0.039		0.010		-0.042
0-year-old Mortality R.	G22		-0.499		0.735		0.602		0.060
Total Fertility R.	G23		0.000		0.000		0.000		0.000
Female Divorce R.	G24		-4.311		-1.661		-0.970		-0.418
Female College Grad. R.	G25		-0.625		0.610		0.501		0.060
One-Child Certificate R.	G26		0.012		-0.054		-0.023		-0.037
For HAN Status		B3	B3	B3	B3	B3	B3	B3	B3
INTRCPT2	G30	-0.144 *	-0.135	0.056 *	0.057 *	0.042	0.047	0.010	0.011
Female Occup. Partici. R.	G31	0.412	0.355	-0.708	-0.713	-0.634	-0.720	0.049	0.086
0-year-old Mortality R.	G32	8.238	6.939	3.923	4.078	4.805	5.178	-0.219	-0.374
Total Fertility R.	G33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G34	-40.512	-34.788	1.719	1.024	2.463	-0.132	-0.059	0.416
Female College Grad. R.	G35	0.612	-0.498	-2.968	-3.266	-3.046	-3.249	-0.522	-0.597
One-Child Certificate R.	G36	5.840	5.816	1.153	1.322	1.824	1.998	-0.121	-0.135
For Wife's Age		B4	B4	B4	B4	B4	B4	B4	B4
INTRCPT2	G40	0.066 *	0.066 *	0.017 *	0.018 *	0.015 *	0.015 *	0.003 *	0.003 *
Female Occup. Partici. R.	G41	0.068	0.048	0.001	-0.003	-0.019	-0.023	0.020	0.020
0-year-old Mortality R.	G42	-0.416	-0.296	-0.214	-0.206	-0.215	-0.206	0.010	0.006
Total Fertility R.	G43	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G44	1.585	0.991	0.200	0.155	0.363	0.311	-0.197	-0.163
Female College Grad. R.	G45	0.191	0.262	-0.378	-0.356	-0.269	-0.254	-0.101	-0.098
One-Child Certificate R.	G46	-0.253	-0.236	-0.045	-0.043	-0.052	-0.050	0.006	0.006
For 3-Gen. Familial Structure		B5	B5	B5	B5	B5	B5	B5	B5
INTRCPT2	G50	-0.631 *	-0.620 *	-0.063 *	-0.062 *	-0.051 *	-0.048 *	-0.012	-0.012
Female Occup. Partici. R.	G51	0.345	0.414	0.121	0.137	0.448 *	0.483 *	-0.355 *	-0.340 *
0-year-old Mortality R.	G52	-12.672 *	-13.729 *	-0.191	-0.550	-0.521	-0.969	0.388	0.322
Total Fertility R.	G53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G54	39.374	49.217	-0.251	1.928	2.022	4.914	-2.317	-2.054

Table 6.12 (Continued)

China Marital Years Less Than 14		Children Ever Born		Sterilization Status		Wife Sterilization Status		Husband Sterilization Status	
Effect	Index	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
Female College Grad. R.	G55	-3.316	-4.157	0.953	0.656	0.288	0.010	0.607	0.596
One-Child Certificate R.	G56	1.774	1.693	0.106	0.060	0.177	0.092	-0.063	-0.063
For Number of Dead Children				B6	B6	B6	B6	B6	B6
INTRCPT2	G60			-0.114 *	-0.114 *	-0.105 *	-0.104 *	-0.007	-0.007
Female Occup. Partici. R.	G61			0.190	0.188	0.295	0.310	-0.053	-0.059
o-year-old Mortality R.	G62			1.647	1.512	0.206	0.059	0.524	0.591
Total Fertility R.	G63			0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G64			-6.374	-5.158	-1.186	-0.025	-1.574	-1.604
Female College Grad. R.	G65			0.683	1.304	1.553	1.941	-0.456	-0.260
One-Child Certificate R.	G66			1.023	0.854	0.228	0.128	0.415	0.383
For Wife's Agri.l Occup.		B6		B7		B7		B7	
INTRCPT2	G70	0.166 *		0.043 *		0.026		0.018	
Female Occup. Partici. R.	G71	0.466		-0.249		-0.251		-0.056	
0-year-old Mortality R.	G72	-0.508		0.161		-0.672		1.376	
Total Fertility R.	G73	0.000		0.000		0.000		0.000	
Female Divorce R.	G74	19.361		1.375		4.832		-4.729	
Female College Grad. R.	G75	4.896		-0.772		-0.852		-0.041	
One-Child Certificate R.	G76	-2.260		-0.216		-0.260		0.145	
For Husband's Agr. Occup.			B6		B7		B7		B7
INTRCPT2	G70		0.110 *		0.016		0.022		-0.004
Female Occup. Partici. R.	G71		-0.638		-0.333		-0.218		-0.095
0-year-old Mortality R.	G72		4.239		0.540		0.525		-0.010
Total Fertility R.	G73		0.000		0.000		0.000		0.000
Female Divorce R.	G74		-20.086		-3.937		-3.943		-0.265
Female College Grad. R.	G75		5.081		0.171		0.153		-0.010
One-Child Certificate R.	G76		-0.677		0.063		0.065		0.001
For No One-child Certificate		B7	B7	B8	B8	B8	B8	B8	B8
INTRCPT2	G80	0.496 *	0.508 *	0.176 *	0.184 *	0.159 *	0.163 *	0.019	0.023
Female Occup. Partici. R.	G81	-0.551	-0.434	0.377	0.340	-0.089	-0.125	0.407	0.387
0-year-old Mortality R.	G82	6.306	6.583	-4.468	-4.481	-2.993	-3.162	-1.323	-1.150
Total Fertility R.	G83	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G84	-33.550	-36.260	7.753	7.125	4.940	4.930	2.964	2.119
Female College Grad. R.	G85	0.953	2.509	-3.681	-3.377	-1.805	-1.647	-1.803	-1.757
One-Child Certificate R.	G86	0.166	-0.059	-0.509	-0.587	-0.721	-0.754	0.159	0.154
For Number of Boys				B9	B9	B9	B9	B9	B9
INTRCPT2	G90			0.119 *	0.120 *	0.102 *	0.103 *	0.017 *	0.017 *
Female Occup. Partici. R.	G91			-0.068	-0.066	-0.181	-0.175	0.111	0.111
o-year-old Mortality R.	G92			-1.371	-1.421	-1.138	-1.164	-0.176	-0.184
Total Fertility R.	G93			0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G94			3.647	3.766	3.637	3.712	-0.134	-0.325
Female College Grad. R.	G95			-0.454	-0.418	-0.003	0.007	-0.483	-0.469
One-Child Certificate R.	G96			-0.498	-0.518	-0.531	-0.542	0.048	0.053
For Childbirth with Quota		B8	B8	B10	B10	B10	B10	10.000	B10
INTRCPT2	G100	-0.496 *	-0.501 *	-0.118 *	-0.119 *	-0.102 *	-0.102 *	-0.016 *	-0.016 *
Female Occup. Partici. R.	G101	2.112	2.051	0.371	0.386	0.511	0.534	-0.154	-0.142
0-year-old Mortality R.	G102	-27.566 *	-27.468 *	-1.398	-1.494	-0.558	-0.716	-0.845	-0.850
Total Fertility R.	G103	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G104	48.944	46.839	-3.149	-2.927	-4.884	-4.430	2.328	2.518
Female College Grad. R.	G105	-3.555	-4.566	2.242	2.084	2.094	1.940	0.199	0.150
One-Child Certificate R.	G106	0.827	1.091	-0.487	-0.466	-0.380	-0.372	-0.151	-0.140

Note: * $p<.05$

Source: SFPCC 1989 and NBSC 1991

Among the main effects of the level-2 variables on the dependent variables in CEB models, from the $G_{01}(\gamma_{01})$ coefficient to G06(γ_{06}), 0-year-old mortality rate (G02) and one-child certificate rate (G06) pass the significance tests and have the same association with CEB, as in Table 6.11. In addition, Female Divorce Rate becomes significant and the higher the percentage of female divorce rate in a province, the lower a province's average expected log of women's CEB. This is in agreement with the hypothesis. No contextual variables show direct significant effects on three of the sterilization status models.

Regarding the main effects of the level-1 variables on the dependent variables, all the coefficients G10, G20 to G100 in the CEB models pass the significance tests either in Model I or Model II. The relationships of coefficients with CEB are identical to those in Table 6.11.

For G10, G20 to G110 of three sterilization status models, most of them have the same results as in Table 6.11. However, for wife's education in this younger population, they significantly affect the sterilization variable, unlike in Table 6.11. Specifically, the $\gamma 20$ coefficient is -0.012 in the couple sterilization model, and -0.013 in the wife sterilization model. So the $\gamma 20$ odds ratios for both are around 0.99. That means that after controlling other variables, comparing two women with a difference of one year in schooling, the woman with one more schooling year will be .99 as likely as the one with one less schooling year to have either her couple or herself be sterilized. Wife's age in this younger population changes its negative association relation with couple's and wife's sterilization in Table 6.11 to positive. This means that for women with marital years less than 14 years, comparing two women with a difference of one year in age, the older woman would be 1.02 as likely as the younger woman to have been sterilized.

Compared with Table 6.11, the cross-level interactions of the level-2 variables on the slope of individual variables on fertility lose several significant variables. The instances are in CEB models, the γ35, Female College Graduation Rate on the slope of wife's educational level, the γ44 of Female Divorce Rate and γ_{45} of Female Divorce Rate on Han status, the γ52 of 0-year-old mortality rate on wife's age, the γ64 of Female Divorce Rate on Three Generation Familial Structure, the γ_{92} of 0-year-old Mortality Rate in Model II of couple's and wife's sterilization models on No One-child Certificate, and the γ116 of One-child Certificate Rate on Childbirth with Quota in wife's sterilization model.

The two cross-level effects that now emerge as significant in Table 6.12 are γ51 of Female Occupation Participation Rate and γ_{52} of 0-year-old Mortality Rate on Three Generation Familial Structure. The γ51 has positive effect on the slope of Three Generation Familial Structure in wife sterilization model; that is, women living in the three-generation familial structure in a province with higher Female Occupation Participation Rate will have a lower wife sterilization rate than those also living in the three-generation familial structure in a province with lower Female Occupation Participation Rate. However, the γ51 has a negative effect on the slope of Three Generation Familial Structure in the husband sterilization model; that is, women living in a three-generation familial structure in a province with higher Female Occupation

Participation Rate will lower the reducing effect of familial structure on husband sterilization rate as compared with those also living in a three-generation familial structure in a province with lower Female Occupation Participation Rate. This may be explained as follows: when people in China perceive in the surrounding context that more women are going out to work like men, women's status rises and she no longer has to shoulder the full responsibility for ending fertility. We see this trend in the γ_{01} coefficient of the direct effect of level-2 Female Occupation Participation Rate on fertility, even though they are not significant. Three-generation familial structure, however, demonstrates this contextual effect. We can suppose that the parents of the couples may facilitate the wives' asserting their rights on issues of ending fertility. So both of the γ_{51} coefficients on the wife sterilization and husband sterilization status fall within hypothetical expectation.

The γ_{52} of 0-year-old Mortality Rate on the depressing effect of Three Generation Familial Structure on CEB is negative; hence, women in a province with higher 0-year-old Mortality Rate can lessen the decreasing effect of three-generation familial structure on CEB. From the γ_{02} of level-2 effect of 0-year-old Mortality Rate has a directly affirmative effect on CEB; this result is not surprising.

Table 6.13

In Table 6.13, I select women who live in rural China in1988. In this population, the γ_{00} coefficient for the CEB Model I in is 2.91, and for the couple sterilization models, the γ_{00} coefficient is 0.357 in Model I and Model II. We change it into a "predicted

Table 6.13 Multilevel Analyses: Effects (Gamma Coefficients) of Individual and Provincial Characteristics on the Likelihood of Number of Children Ever Born and Being Sterilized: 1988 China Data—Living in Rural Area.

China Rural		Children Ever Born		Sterilization Status		Wife Sterilization Status		Husband Sterilization Status	
Effect	Index	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
For INTRCPT1									
INTRCPT2	G00	2.906 *	2.904 *	0.357 *	0.357 *	0.302 *	0.302 *	0.056 *	0.056 *
INTRCPT2	G00	2.906 *	2.904 *	0.357 *	0.357 *	0.302 *	0.302 *	0.056 *	0.056 *
Female Occup. Partici. R.	G01	-1.240	-1.247	-0.374	-0.374	-0.887 *	-0.888 *	0.515	0.514
0-year-old Mortality R.	G02	26.053 *	26.164 *	-1.166	-1.167	-1.447	-1.445	0.294	0.310
Total Fertility R.	G03	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G04	-44.222 *	-44.636 *	2.699	2.684	4.249	4.195	-1.592	-1.663
Female College Grad. R.	G05	10.693	10.687	-5.720	-5.723	-3.441	-3.434	-2.274	-2.281
One-Child Certificate R.	G06	-4.594 *	-4.579 *	-0.501	-0.499	-0.947	-0.948	0.435	0.443
For Married More than 14 years		B1	B1	B1	B1	B1	B1	B1	B1
INTRCPT2	G10	0.085	0.087	0.052 *	0.054 *	0.052 *	0.053 *	0.002	0.003
Female Occup. Partici. R.	G11	-1.106	-1.063	0.221	0.221	0.112	0.103	0.139	0.152
0-year-old Mortality R.	G12	2.981	3.073	1.707	1.704	0.723	0.714	0.945	0.877
Total Fertility R.	G13	0.000	0.000	0.000 *	0.000 *	0.000 *	0.000 *	0.000	0.000
Female Divorce R.	G14	-32.756	-34.868	8.033	8.402	9.888	10.508	-0.490	-0.402
Female College Grad. R.	G15	-5.224	-5.325	-2.977	-2.887	-2.909	-2.832	-0.477	-0.485
One-Child Certificate R.	G16	3.483	3.514	0.214	0.146	-0.041	-0.128	0.362	0.339
For Wife's Education		B2		B2		B2		B2	
INTRCPT2	G20	-0.054 *		-0.005		-0.004		0.000	
Female Occup. Partici. R.	G21	0.219		-0.045		-0.007		-0.034	
0-year-old Mortality R.	G22	-1.261		0.595		0.401		0.188	
Total Fertility R.	G23	0.000		0.000		0.000		0.000	
Female Divorce R.	G24	1.360		-1.980		-1.766		-0.183	
Female College Grad. R.	G25	-4.680 *		-0.414		-0.422		0.065	
One-Child Certificate R.	G26	0.159		0.129		0.134		-0.016	
For Husband's Education			B2		B2		B2		B2
INTRCPT2	G20		-0.054 *		0.011 *		0.008 *		0.003
Female Occup. Partici. R.	G21		-0.048		-0.028		-0.003		-0.022
0-year-old Mortality R.	G22		0.121		0.163		0.132		0.032
Total Fertility R.	G23		0.000		0.000		0.000		0.000
Female Divorce R.	G24		-0.277		-0.467		-0.044		-0.547
Female College Grad. R.	G25		-3.199		0.431		0.124		0.223
One-Child Certificate R.	G26		0.228		-0.054		0.042		-0.079
For HAN Status		B3	B3	B3	B3	B3	B3	B3	B3
INTRCPT2	G30	-0.039	-0.022	0.067 *	0.063 *	0.058 *	0.060 *	0.009	0.007
Female Occup. Partici. R.	G31	1.573	0.888	-0.669	-0.625	-0.492	-0.511	-0.003	0.018
0-year-old Mortality R.	G32	12.850	15.146	2.226	2.023	1.997	2.301	-0.341	-0.312
Total Fertility R.	G33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G34	-76.587 *	-82.144 *	8.508	8.542	10.924	9.028	1.334	1.742
Female College Grad. R.	G35	-12.886	-16.977	-3.717	-3.823	-3.208	-3.602	-0.848	-0.871
One-Child Certificate R.	G36	13.806 *	15.559 *	0.772	0.608	0.957	1.136	-0.307	-0.278
For Wife's Age		B4	B4	B4	B4	B4	B4	B4	B4
INTRCPT2	G40	0.102 *	0.102 *	-0.004 *	-0.004 *	-0.005 *	-0.005 *	0.000	0.000
Female Occup. Partici. R.	G41	0.021	0.006	0.007	0.011	0.013	0.016	-0.008	-0.008
0-year-old Mortality R.	G42	-0.478	-0.396	0.010	-0.012	0.042	0.025	-0.024	-0.027
Total Fertility R.	G43	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G44	2.791	2.339	-0.503	-0.434	-0.570	-0.507	-0.041	-0.044
Female College Grad. R.	G45	0.154	0.291	-0.109	-0.076	-0.063	-0.036	-0.014	-0.007
One-Child Certificate R.	G46	-0.001	0.019	0.070	0.069	0.062	0.062	0.000	-0.001
For 3-Gen. Familial Structure		B5	B5	B5	B5	B5	B5	B5	B5
INTRCPT2	G50	-0.472 *	-0.470 *	-0.175 *	-0.176 *	-0.150 *	-0.152 *	-0.024 *	-0.025 *
Female Occup. Partici. R.	G51	0.614	0.592	0.141	0.152	0.588	0.603 *	-0.506 *	-0.513 *
0-year-old Mortality R.	G52	-10.880	-10.506	1.425	1.191	1.085	0.907	0.367	0.528
Total Fertility R.	G53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 6.13 (Continued)

China Rural		Children Ever Born		Sterilization Status		Wife Sterilization Status		Husband Sterilization Status	
Effect	Index	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
Female Divorce R.	G54	33.549	28.673	-11.437	-8.357	-9.024	-7.221	-2.512	-3.227
Female College Grad. R.	G55	-3.003	-3.761	3.577	3.447	2.509	2.495	1.137	1.166
One-Child Certificate R.	G56	3.018	3.226	0.571	0.519	0.592	0.534	-0.085	-0.040
For Number of Dead Children				B6	B6	B6	B6	B6	B6
INTRCPT2	G60			-0.084 *	-0.082 *	-0.073 *	-0.071 *	-0.012 *	-0.011 *
Female Occup. Partici. R.	G61			0.111	0.109	0.200	0.198	-0.106	-0.103
o-year-old Mortality R.	G62			0.964	0.920	0.622	0.628	0.189	0.167
Total Fertility R.	G63			0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G64			-0.873	-0.627	0.326	0.219	-0.428	-0.401
Female College Grad. R.	G65			1.082	1.443	1.045	1.268	0.357	0.348
One-Child Certificate R.	G66			0.424	0.335	0.209	0.185	0.078	0.073
For Wife's Agricultural Occup.		B6		B7		B7		B7	
INTRCPT2	G70	0.200 *		0.050 *		0.024		0.025 *	
Female Occup. Partici. R.	G71	1.116		-0.193		-0.319		0.084	
0-year-old Mortality R.	G72	-0.001		1.642		1.290		0.648	
Total Fertility R.	G73	0.000		0.000		0.000		0.000	
Female Divorce R.	G74	34.058		2.365		2.430		-1.834	
Female College Grad. R.	G75	1.438		-1.627		-0.962		-0.828	
One-Child Certificate R.	G76	-1.576		0.275		0.226		0.190	
For Husband's Agri. Occup.			B6		B7		B7		B7
INTRCPT2	G70		0.139 *		0.002		0.001		0.002
Female Occup. Partici. R.	G71		-0.705		-0.236		-0.201		-0.017
0-year-old Mortality R.	G72		10.540 *		-0.080		-0.093		-0.027
Total Fertility R.	G73		0.000		0.000		0.000		0.000
Female Divorce R.	G74		-46.252 *		-6.018		-6.980		0.780
Female College Grad. R.	G75		4.379		-1.878		-1.589		-0.400
One-Child Certificate R.	G76		1.549		0.721		0.592		0.148
For No One-child Certificate		B7	B7	B8	B8	B8	B8	B8	B8
INTRCPT2	G80	0.787 *	0.771 *	0.170 *	0.173 *	0.155 *	0.155 *	0.008	0.014
Female Occup. Partici. R.	G81	-0.425	-0.436	0.052	0.013	-0.460	-0.467	0.350	0.348
0-year-old Mortality R.	G82	12.995	12.920	-4.416	-4.268	-3.332	-3.585	-1.612	-1.733
Total Fertility R.	G83	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G84	-27.705	-39.279	0.566	-1.653	-2.423	-3.897	3.791	3.683
Female College Grad. R.	G85	9.067	10.789	-3.001	-2.756	-1.387	-1.296	-1.866	-1.909
One-Child Certificate R.	G86	-1.110	-1.168	-0.071	-0.105	-0.372	-0.395	0.307	0.268
For Number of Boys				B9	B9	B9	B9	B9	B9
INTRCPT2	G90			0.051 *	0.051 *	0.041 *	0.041 *	0.010 *	0.010 *
Female Occup. Partici. R.	G91			-0.001	0.003	-0.088	-0.085	0.085	0.083
o-year-old Mortality R.	G92			-0.137	-0.111	-0.274	-0.243	0.218	0.227
Total Fertility R.	G93			0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G94			-1.653	-1.975	-1.536	-1.887	-0.812	-0.847
Female College Grad. R.	G95			-0.005	0.144	0.301	0.360	-0.298	-0.298
One-Child Certificate R.	G96			-0.168	-0.174	-0.250	-0.231	0.098	0.098
For Childbirth with Quota		B8	B8	B10	B10	B10	B10	B10	B10
INTRCPT2	G100	-0.572 *	-0.576 *	-0.180 *	-0.182 *	-0.163 *	-0.164 *	-0.019	-0.020 *
Female Occup. Partici. R.	G101	1.717	1.733	0.498	0.503	0.733 *	0.747 *	-0.251	-0.263
0-year-old Mortality R.	G102	-31.798 *	-31.761 *	-1.065	-1.142	0.004	-0.125	-0.914	-0.797
Total Fertility R.	G103	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G104	62.192	60.983	-7.286	-5.882	-10.469	-9.242	1.571	1.382
Female College Grad. R.	G105	-2.797	-3.898	3.256	3.206	2.505	2.346	0.978	1.009
One-Child Certificate R.	G106	5.204	5.341	-0.421	-0.468	-0.200	-0.234	-0.257	-0.234

Note: * $p<.05$

Source: SFPCC 1989 and NBSC 1991

probability." The probability of being sterilized for Chinese married couples with average values on all the predictors is .59, which is the highest among the three tables. For wife's sterilization status, the coefficient in Model I is 0.302; so the probability for wives being sterilized is 57%. The coefficient for husband's sterilization is 0.056; so the probability for wives' husbands' being sterilized is 51%. We can say rural people have a higher expected sterilization rate.

Among the main effects of the level-2 variables on the dependent variables in CEB models, from the $G_{01}(\gamma_{01})$ coefficient to G06(γ_{06}), 0-year-old mortality rate (G02), Female Divorce Rate (G04) and one-child certificate rate (G06) pass the significance test and have the same association with CEB as in Table 6.12. The γ_{01} of Female Occupation Participation has direct and significant effects on the wife sterilization status models. The higher the female occupation participation rate in a province, the lower a province's average expected log odds of women having been sterilized, which is not against the hypothesis.

Regarding the main effects of the level-1 variables on the dependent variables, except for the variable of marital years more than 14, which loses its significant effect in the rural group, the other variables of G10, G20 to G100 in CEB models pass the significance tests either in Model I or Model II. The relationships of coefficients with CEB are identical to those in Table 6.11.

For G10, G20 to G110 of the three sterilization status models, most of them have similar results to those in Table 6.11. However, wife's education in the previous younger population passes the significance test on the Couple Sterilization Model and the Wife

Sterilization Model, but fails in the rural group. on the other hand, husband's education affects the couple sterilization model and wife sterilization model, but unlike wife's education, it has a positive effect on the couple sterilization and wife sterilization status: specifically, the $\gamma20$ coefficient is 0.011 in the Couple Sterilization Model, and 0.008 in the Wife Sterilization Model. So the $\gamma20$ odds ratios for both are around 1.01. It means that after controlling for the other variables, comparing two women's husbands with a difference of one year in schooling, the woman's husband with one more schooling year will be 1.01 as likely as the one with one less year of schooling to have her couple or herself be sterilized. This is not what I hypothesized.

Wife's age in this rural population changes its positive association with couple's and wife's sterilization in Table 6.12 to negative, as in Table 6.11. It means that for women who live in a rural area, comparing two women with a difference of one year in age, the older woman would be around .996 as likely as the younger woman to have her couple or herself be sterilized.

In comparison with Table 6.11, the cross-level interactions of the level-2 variables on the slope of individual variables on fertility in Table 6.13 lose several significant variables. In addition, the γ_{52} of 0-year-old Mortality Rate on Three Generation Familial Structure fails the significance test. However, as in Table 6.12, the $\gamma51$ of Female Occupation Participation Rate on Three Generation Familial Structure have different directional effects. The interaction strengthens as regards wife sterilization status (i.e., making wife's sterilization less likely, as in Table 6.12), but, on husband sterilization status, the interaction debilitates the effect of the three-generation familial to lower husbands' sterilization.

The three newly significant cross-level effects in Table 6.13 are the $\gamma 72$ of 0-year-old Mortality Rate and the $\gamma 74$ of Female Divorce Rate on Husband's Agricultural Occupation, and the γ_{101} of Female Occupation Participation Rate on the Experience of Childbirth within Quota. The $\gamma 72$ has a positive effect on the slope of Husband's Agricultural Occupation in CEB mode, which fits perfectly with the hypothesis, because higher 0-year-old Mortality Rate will promote a higher CEB. Through the husband's agricultural job, it should boost this inclination. The γ_{74} has negative effect on the slope of Husband's Agricultural Occupation in CEB model; that is, women who have husbands who work in an agricultural occupation, living in a province with higher Female Divorce Rate will have a smaller number of CEB than those whose husbands are also farmers in a province with lower Female Divorce Rate. This falls within the hypothesis. In wife's sterilization models, the Female Occupation Participation Rate has a positive effect on the slope of experience of childbirth within quota. That is, women, who have experience of childbirth within quota, living in a province of higher Female Occupation Participation Rate, will have a lower wife's sterilization rate than those who have experience of childbirth within quota living in a province with lower Female Occupation Participation Rate. At the macro level, it complies with the hypothesis that Female Occupation Participation Rate leads to lower wife's sterilization rate.

The Discussion of Table 6.11, Table 6.12 and Table 6.13, China Data

Judging from these three HGLM tables using 1988 China data, three groups display somewhat different results. Table 6.12 of the younger group looks different than the other models, because rural people make up most of the population. It is also possible that the level-2 and level-1 variables have insignificant explanatory power for the husband sterilization models, because the dependent variable (number of husbands' sterilizations) is less than that of the wife's.

Among six level-2 effects, Total Fertility Rate and Female College Graduation Rate do not have apparent effects on these models. The two policy variables--No One-child Certificate and Experience of Childbirth within Quota—show greater statistical significance on the sterilization models than do the two women's statuses—education and farming status. Among 23 significant cross-level effects in these three tables, most of them come out in accordance with the hypothetical expectations. However, there are five significant cross-level effects that run counter to the hypotheses. Included are the provincial level Female Divorce Rate interacting with Han status in the whole sample, with Han status in the rural sample, and with Three Generation Familial Structure in the whole sample. The provincial level Female College Graduation Rate interacts with wife's education in the whole sample, as well as with wife's education in the rural sample.

Table 6.14

The 1992 Taiwan data, are analyzed in Table 6.14. As mentioned before, the intercepts(G_{00} or γ_{00}) in the HGLM models for the outcome variable of CEB represent

Table 6.14 Multilevel Analyses: Effects (Gamma Coefficients) of Individual and County Characteristics on the Likelihood of Number of Children Ever Born and Being Sterilized: 1992 Taiwan Data.

Taiwan All		Children Ever Born		Sterilization Status		Wife Sterilization Status		Husband Sterilization Status	
Effect	Index	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
For INTRCPT1	B0		tcII						B0
INTRCPT2	G00	0.900 *	0.902 *	-1.040 *	-1.043 *	-1.125 *	-1.129 *	-4.898 *	-4.926 *
Female Occup. Partici. R.	G01	-0.103	-0.106	-0.544	-0.566	-0.534	-0.583	0.953	0.967
o-year-old Mortality R.	G02	0.002 *	0.002 *	0.003	0.004	0.005	0.005	-0.041 *	-0.041
Total Fertility R.	G03	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002
Female Divorce R.	G04	-0.024 *	-0.024 *	-0.106 *	-0.107 *	-0.112 *	-0.112 *	0.182	0.164
Female College Grad. R.	G05	-0.917 *	-0.916 *	-5.992 *	-6.033 *	-6.747 *	-6.786 *	5.384	5.228
For Wife's Education	B1			B1		B1		B1	
INTRCPT2	G10	-0.038 *		-0.078 *		-0.084 *		0.042	
Female Occup. Partici. R.	G11	-0.013		0.033		0.066		-0.309	
o-year-old Mortality R.	G12	0.000		0.000		0.000		0.000	
Total Fertility R.	G13	-0.000 *		0.000		0.000		0.000	
Female Divorce R.	G14	-0.002 *		-0.001		-0.001		-0.004	
Female College Grad. R.	G15	-0.031		-0.167		-0.326		0.511	
For Husband's Education	B1		B1		B1		B1		B1
INTRCPT2	G10		-0.031 *		-0.072 *		-0.080 *		0.073
Female Occup. Partici. R.	G11		-0.035		-0.051		-0.059		0.042
o-year-old Mortality R.	G12		0.000		0.000		0.000		0.003
Total Fertility R.	G13		0.000		0.000		0.000		0.000
Female Divorce R.	G14		-0.001		-0.004		-0.003		-0.020
Female College Grad. R.	G15		0.025		-0.155		-0.247		-0.216
For Nowork Status	B2		B2	B2	B2	B2	B2	B2	B2
INTRCPT2	G20	0.050 *	0.044 *	0.079 *	0.059	0.085 *	0.064	-0.025	-0.033
Female Occup. Partici. R.	G21	-0.107	-0.127	-1.361 *	-1.669	-1.655 *	-1.984	2.972	3.369
o-year-old Mortality R.	G22	0.000	0.000	-0.003	-0.003	-0.005	-0.005	0.029	0.029
Total Fertility R.	G23	0.000	0.000	0.000	0.000	0.000	0.000	-0.002	-0.002
Female Divorce R.	G24	0.001	-0.002	-0.025	-0.037	-0.014	-0.023	-0.205	-0.263
Female College Grad. R.	G25	0.432	0.588	3.073 *	3.607	3.035 *	3.623	-1.702	-2.523 *
For Wife's Age	B3		B3	B3	B3	B3	B3	B3	B3
INTRCPT2	G30	0.030 *	0.034 *	0.075 *	0.083 *	0.069 *	0.077 *	0.116 *	0.115
Female Occup. Partici. R.	G31	0.000	0.003	-0.040	-0.045	-0.027	-0.039	-0.211	-0.133
o-year-old Mortality R.	G32	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Total Fertility R.	G33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G34	0.000	0.000	0.002	0.001	0.002	0.001	-0.013	-0.015
Female College Grad. R.	G35	0.052	0.046	0.285	0.285	0.224	0.252	0.299	0.188
For Whether owning Piano	B4		B4	B4	B4	B4	B4	B4	B4
INTRCPT2	G40	0.024 *	0.009 *	0.230 *	0.216 *	0.216 *	0.211 *	0.404	0.287
Female Occup. Partici. R.	G41	0.107	0.166	0.506	0.724	0.221	0.556	4.566	3.795
o-year-old Mortality R.	G42	-0.001 *	-0.001	-0.010	-0.012	-0.010	-0.012	0.023	0.016
Total Fertility R.	G43	0.000	0.000	0.001	0.001	0.001	0.001	-0.003	-0.003
Female Divorce R.	G44	0.013 *	0.014	-0.015	0.009	-0.009	0.012	-0.145	-0.114
Female College Grad. R.	G45	0.076	-0.221	0.219	-0.180	2.194	1.455	-21.998	-19.733
For 3-Gene. Familial Structure	B5		B5	B5 *	B5	B5	B5	B5	B5
INTRCPT2	G50	0.014 *	0.018 *	0.021	0.027	0.040	0.049	-0.222	-0.216
Female Occup. Partici. R.	G51	0.122	0.141	0.511	0.578	0.528	0.616	-0.252	-0.439
o-year-old Mortality R.	G52	0.000	0.000	-0.003	-0.003	-0.003	-0.003	0.001	0.000
Total Fertility R.	G53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 6.14 (Continued)

Taiwan All		Children Ever Born		Sterilization Status		Wife Sterilization Status		Husband Sterilization Status	
Effect	Index	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
Female Divorce R. G54	-0.004	-0.004	-0.005	-0.003	-0.003	0.000	-0.022	-0.029	
Female College Grad. R.	G55	-0.244	-0.301	0.950	0.955	1.063	1.128	2.284	1.642 *
For Mainlander Status	B6		B6	B6	B6	B6	B6	B6	B6
INTRCPT2	G60	-0.124 *	-0.125 *	-0.127 *	-0.113 *	-0.262 *	-0.248 *	0.902 *	0.878
Female Occup. Partici. R.	G61	-0.012	0.022	-0.095	-0.001	0.140	0.213	-2.133	-2.795
o-year-old Mortality R.	G62	0.001	0.001	0.007 *	0.007	0.008 *	0.007	0.024	0.025
Total Fertility R.	G63	0.000	0.000	0.000	0.000	0.000	0.000	-0.002	-0.001
Female Divorce R.	G64	0.004	0.007	0.002	0.010	0.009	0.018	-0.090	-0.072
Female College Grad. R.	G65	0.487	0.360	1.687	1.893	2.243	2.368	-5.927	-4.607 *
For Number of Dead Children	B7			B7	B7	B7	B7	B7	B7
INTRCPT2	G70			-0.168	-0.166	-0.131	-0.129	-4.540 *	-4.325
Female Occup. Partici. R.	G71			0.934	1.046	1.159	1.298	2.887	2.900
o-year-old Mortality R.	G72			0.002	0.002	0.003	0.003	-0.136	-0.120
Total Fertility R.	G73			0.000	0.000	0.000	0.000	0.004	0.003
Female Divorce R.	G74			0.150 *	0.153 *	0.123 *	0.127	2.051	1.914
Female College Grad. R.	G75			-11.953 *	-12.781 *	-9.843 *	-10.684	-14.920	-19.303
For Wife's Agricultural Occup.	B8			B8		B8		B8	
INTRCPT2	G80	0.075*		0.423 *		0.460 *		-2.787	
Female Occup. Partici. R.	G81	0.180		3.473		3.629 *		3.741	
o-year-old Mortality R.	G82	-0.001		-0.009		-0.007		0.023	
Total Fertility R.	G83	0.000		-0.001		-0.002		-0.004	
Female Divorce R.	G84	0.038 *		0.117		0.081		0.305	
Female College Grad. R.	G85	-1.330		-2.079		-1.778		173.392	
For Husband's Agricultural	B8		B7		B8		B8		B8
INTRCPT2	G80		0.094 *		0.266 *		0.306 *		-2.561
Female Occup. Partici. R.	G81		-0.301		0.570		0.637		-2.153
o-year-old Mortality R.	G82		0.000		-0.003		-0.003		0.043
Total Fertility R.	G83		0.000		0.001		0.000		0.003
Female Divorce R.	G84		0.028		0.070		0.054		0.077
Female College Grad. R.	G85		-0.336		4.508		5.310		109.217
For Number of Boys	B9			B9	B9	B9	B9	B9	B9
INTRCPT2	G90			0.622 *	0.636	0.622 *	0.635	0.202	0.215
Female Occup. Partici. R.	G91			-0.541	-0.517	-0.618	-0.602	0.658	0.819
o-year-old Mortality R.	G92			-0.003	-0.003	-0.003	-0.003	0.002	0.004
Total Fertility R.	G93			0.000	0.000	0.000	0.000	-0.001	-0.001
Female Divorce R.	G94			-0.051 *	-0.051 *	-0.049 *	-0.048 *	-0.023	-0.027
Female College Grad. R.	G95			3.222 *	3.050 *	3.245 *	3.096 *	-0.919	-1.590

Note: ***** $p<.05$

Source: TPIFP 1992, and EYRC 1992

the grand mean of the log of the number of children ever born, or log odds of being sterilized for sterilization status, for Taiwanese married women with average values on all the predictors. The γ_{00} coefficient for the CEB Model I in is 0.900. For Couple Sterilization models, the γ_{00} coefficient is -1.04 in Model I. It can be converted into a “predicted probability.” The probability of being sterilized for Taiwanese married women or their husbands with average values on all the predictors is .26. For wife’s sterilization status, the coefficient in Model I is -1.125, so the probability for wives being sterilized is 25%. The coefficient in Model I for husband’s sterilization is -4.898, so the probability for wives’ husbands being sterilized is 1%.

The G_{01}(γ_{01}) coefficient to G05(γ_{05}) reflect the main effects of the level-2 variables on the dependent variables. In the CEB models, 0-year-old Mortality Rate (G02), Female Divorce Rate (G04) and Female College Graduation Rate (G05) pass the significance test. The higher the percentage of 0-year-old mortality rate in a county, the higher the county’s average expected log of women’s CEB. The association accords with the hypothesis. on the other hand, it has a negative effect on the husband’s sterilization status, which is also logical. Regarding the other two aggregate variables with higher women’s status implications, higher Female Divorce Rate (G04) and Female College Graduation Rate (G05) in a county, the lower the county’s average expected log of women’s CEB and the couple’s and wife’s sterilization rate. This is in agreement with the hypothesis, as well.

G10, G20 to G90 are the main effects of the level-1 variables on the dependent variables. For the CEB models in Table 6.14, all the individual-level variables pass the significance test. The relationships of coefficients with CEB are similar to those in Table 6.5 for the Poisson individual-level analysis. The γ_{10} coefficient is -0.038, i.e., odds ratio= $e^{-0.038}$ =0.96. This is the main effect of wife's educational level on the log of children ever born. Comparing two women with a difference of one year in schooling, the woman with one more schooling year is predicted to have 4% fewer children ever born than the other woman. The γ_{20} odds ratio of Nowork Status is 1.05, so, after controlling for the other variables, women who are not working will have 5% more CEB than working women. The γ_{30} odds ratio of Wife's age is 1.03 and the γ_{40} odds ratio of owning piano fails to pass the significance test in the Poisson individual-level analysis but, importantly, is 1.02. Unlike China, Three-generation Familial Structure has a positive effect on CEB, which supports the hypothesis. The γ_{50} odds ratio of Three-generation Familial Structure is 1.01. The γ_{80} odds ratio of Wife's Agricultural Occupation is 1.07; so, after controlling other variables, farming women will have 7% more CEB than non-farming women. The γ_{60} odds ratio of Mainlander is .88; hence, Mainlander women will have 12% fewer CEB than non-Mainlander women.

For G10, G20 to G110 of three sterilization status models, the G10 of wife's and husband's educational level pass the significance test on the couple and wife models. All of them show negative effects. Therefore, women or their husbands with higher education will be less likely to have couples' or wives' sterilization. The G20 of wife not working status will have the couple and the wife 8% more likely to be sterilized than those who are working. The G30 of wife's age has a positive effect on couple and wife sterilization status. Owning piano status also has a positive influence on couple and wife sterilization usage, the same as the logistic analysis in Table 6.7. The G50 of familial structure fail to pass the significance test, the same as the logistic analysis in Table 6.7. Also the same as in Table 6.7, the G60 of Mainlander status has negative effects on couple and wife sterilization but positive on husband's sterilization. Unlike Table 6.7, G70 of Number of Dead Children is significant in discouraging husband sterilization, but Number of Boys loses its significant effect on husband sterilization. Regarding Agricultural Occupation status, wife's and husband's Agricultural Occupation status (γ_{80}) in couple and wife sterilization status model are statistically significant. The coefficient is 0.423 for wife's agricultural status, which means that a farming wife would have a log odds of couple or wife sterilization that is .274 higher than a non-farming wife. Its odds ratio of Wife's Agricultural Occupation is 1.52; so, after controlling other variables, farming women will have 52% more probability of couple or wife sterilization than non-farming women.

Regarding the cross-level interaction involving the level-2 variables on the slope of individual variables on fertility, in CEB models, the γ_{13} of Total Fertility Rate and γ_{14} of Female Divorce Rate are significant and influence the slope of wife's education on CEB, and they have the same negative direction. It suggests that for women living in a county with higher a Total Fertility Rate, the depressing effect of schooling level on CEB will be lower than those living in a county with lower Total Fertility Rate. However, strangely, Female Divorce Rate also weakens the negative effect of wife's educational level on CEB. It is against the hypothesis. The same situation is in the γ_{42} of 0-year-old Mortality Rate and γ_{44} of Female Divorce Rate on the slope of owning piano status. For women living in a county with higher Female Divorce Rate, the affirmative effect of owning a piano on CEB will be higher than for those living in a county with lower Female Divorce Rate. Conversely to the effect of Female Divorce Rate, 0-year-old Mortality Rate weakens the supportive effect of owning a piano on CEB. Both results are not expected. Female Divorce Rate also functions as a conservative power on the slope of wife's agricultural occupation on the CEB. The γ_{84} coefficient of Female Divorce Rate is 0.038. It suggests that for every increase of 1% in the female divorce rate in a county, the slope of wife's farmer status on the log number of children ever born would increase by .038. Female divorce rate is regarded as the women's status index and its direct level-2 (G04) tends to confirm this characterization. It really needs further investigation of why the female divorce rate as a contextual variable shows this unexpected effect.

Regarding the cross-level effects in the sterilization status models, the γ_{21} of Female Occupation Participation Rate has a significantly negative effect on the slope of no work status in the couple and wife sterilization models. It suggests that for women living in a county with a higher Female Occupation Participation Rate, the positive effect of no work status on couple and wife sterilization will be lower than those living in a county with lower Female Occupation Participation Rate. It falls within the hypothetical expectation. Surprisingly, Female College Graduation Rate has a positive effect on the slope of no-work status. I expected that it would not support the tendency of aiding female sterilization. The γ_{62} of 0-year-old Mortality Rate has a positive influence on the depressing slope of Mainlander status on couple and wife sterilization rate. It is not expected.

The γ_{74} coefficient of Female Divorce Rate and the γ_{75} coefficient of Female College Graduation Rate have significant influence on the slope of Number of Dead Children on couple and wife sterilization rate, even though they have different directions. It indicates that for women living in a county with higher Female Divorce Rate, the depressing effect of dead children on couple and wife sterilization will be stronger than for those living in a county with lower Female Divorce Rate, after controlling for the other variables. Women who have experienced dead childbirths, living in a county with higher Female Divorce Rate, will be less likely to use sterilization to end fertility than those who lose the same number of children but live in a county with lower female divorce rate, after controlling for the other variables. This is an expected outcome.

However, unlike the Female Divorce Rate, Female College Graduation Rate weakens the diminishing effect of dead children on couple and wife sterilization. The γ_{81} coefficient of Female Occupation Participation Rate strengthens the positive effect of wife agricultural occupation on wife's sterilization. Neither result was expected. The Female Divorce Rate has a negative effect on the slope of Number of Boys, but the γ_{95} coefficient of Female College Graduation Rate has a positive effect on the Number of Boys. It is expected that Female Divorce Rate will act against the positive effect of son preference on couple and wife sterilization. Once in a context where women's status is higher, women may be more likely to escape sterilization. Therefore, it is against expectation that higher Female College Graduation Rate fortifies the tendency of son preference to encourage sterilization of wives.

Table 6.15

In Table 6.15 are the cases from the 1992 Taiwan KAP data, in which the population's age is younger than 35. The γ_{00} coefficient for the CEB Model I is 2.158. For Couple Sterilization models, the γ_{00} coefficient is 0.207 in Model I. It can be converted into a "predicted probability." The probability of being sterilized for Taiwanese couples under 35 years old with average values on all the predictors is .55. For wife's sterilization status, the coefficient in Model I is 0.199, so the probability for wives being sterilized is also around 55. The coefficient in Model I for husband's sterilization is -5.942, so the probability for wives' husbands' being sterilized is 0.02%. As in Table 6.12 for the younger Chinese group, the log of CEB, the predicted probabilities for couple and wife sterilization status for this younger group are greater than for the overall group. However, in China younger wive's husbands have a higher predicted probability of sterilization than the overall group. By contrast, in Taiwan the sterilization rate of younger wives' husbands is even lower than for the overall group.

The G_{01}(γ_{01}) to the G05(γ_{05}) coefficient are the main effects of the level-2 variables on the dependent variables. In the CEB models, just 0-year-old Mortality Rate (G02) and Female Divorce Rate (G04) pass the significance test. Female College Graduation Rate (G05) fails to show significance in this table. The higher the percentage of 0-year-old mortality rate in a county, the higher the county's average expected log of

Table 6.15 Multilevel Analyses: Effects (Gamma Coefficients) of Individual and County Characteristics on the Likelihood of Number of Children Ever Born and Being Sterilized: 1992 Taiwan Data—Age Younger Than 35 Years Old.

Taiwan 35yrs Younger		Children Ever Born		Sterilization Status		Wife Sterilization Status		Husband Sterilization Status	
Effect	Index	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
For INTRCPT1	B0								
INTRCPT2	G00	2.158 *	2.158 *	0.207 *	0.207 *	0.199 *	0.199 *	-5.942 *	-5.712 *
Female Occup. Partici. R.	G01	-0.244	-0.243	-0.098	-0.104	-0.109	-0.115	2.058	2.130
o-year-old Mortality R.	G02	0.005 *	0.005 *	0.001	0.001	0.001	0.001	-0.066	-0.046 *
Total Fertility R.	G03	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001
Female Divorce R.	G04	-0.064 *	-0.064 *	-0.022 *	-0.022 *	-0.022 *	-0.023 *	0.164	0.123
Female College Grad. R.	G05	-1.824	-1.842	-0.651	-0.635	-0.682	-0.664	7.644	4.046
For Wife's Education	B1	B1		B1		B1		B1	
INTRCPT2	G10	-0.112 *		-0.018 *		-0.019 *		0.094	
Female Occup. Partici. R.	G11	0.028		0.077 *		0.075 *		0.131	
o-year-old Mortality R.	G12	0.000		0.000		0.000		0.004	
Total Fertility R.	G13	0.000		0.000		0.000		-0.001	
Female Divorce R.	G14	0.000		0.001		0.001		-0.034	
Female College Grad. R.	G15	-0.190		-0.156		-0.134		-3.245	
For Husband's Education	B1		B1		B1		B1		B1
INTRCPT2	G10		-0.090 *		-0.017 *		-0.018 *		0.107
Female Occup. Partici. R.	G11		-0.059		0.022		0.019		0.120
o-year-old Mortality R.	G12		0.000		0.000		0.000		0.003
Total Fertility R.	G13		0.000		0.000		0.000		0.000
Female Divorce R.	G14		0.003		0.001		0.001		-0.022
Female College Grad. R.	G15		-0.071		-0.044		-0.046		-0.373
For Nowork Status	B2		B2	B2	B2	B2	B2	B2	B2
INTRCPT2	G20	0.161 *	0.152 *	0.016	0.014	0.015	0.013	-0.023	-0.054
Female Occup. Partici. R.	G21	-0.309	-0.352	-0.329	-0.367	-0.363	-0.400 *	5.614	5.529
o-year-old Mortality R.	G22	0.001	0.001	-0.001	-0.001	-0.001	-0.001	0.015	0.004
Total Fertility R.	G23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001
Female Divorce R.	G24	0.001	-0.006	-0.001	-0.002	0.001	-0.001	-0.315	-0.355
Female College Grad. R.	G25	0.799	1.049	0.422	0.483	0.360	0.421	2.796	1.396
For Wife's Age	B3	B3	B3	B3	B3	B3	B3	B3	B3
INTRCPT2	G30	0.104 *	0.113 *	0.022 *	0.024 *	0.021 *	0.023 *	0.227 *	0.206 *
Female Occup. Partici. R.	G31	0.017	0.019	-0.001	-0.007	-0.008	-0.013	0.941	0.802
o-year-old Mortality R.	G32	0.001	0.001 *	0.000	0.000	0.000	0.000	0.001	-0.001
Total Fertility R.	G33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G34	-0.007	-0.006	-0.002	-0.002	-0.002	-0.002	-0.032	-0.029
Female College Grad. R.	G35	0.080	0.084	-0.113	-0.098	-0.108	-0.094	-1.620	-1.214
For Whether owning Piano	B4	B4	B4	B4	B4	B4	B4	B4	B4
INTRCPT2	G40	0.049	0.015	0.040	0.037	0.036	0.033	0.305	0.326
Female Occup. Partici. R.	G41	-0.352	-0.019	-0.008	0.075	0.021	0.110	-2.302	-2.473
o-year-old Mortality R.	G42	-0.007	-0.008	-0.002	-0.002	-0.002	-0.002	-0.004	-0.004
Total Fertility R.	G43	0.000	0.000	0.000	0.000	0.000	0.000	-0.002	-0.004
Female Divorce R.	G44	0.064	0.065	0.006	0.005	0.008	0.007	-0.243	-0.280
Female College Grad. R.	G45	0.864	0.093	0.143	-0.077	0.403	0.200	-20.912	-26.739
For 3-Gene. Familial Structure	B5		B5	B5	B5	B5	B5	B5	B5
INTRCPT2	G50	0.069	0.072	0.001	0.003	0.004	0.007	-0.616	-0.567
Female Occup. Partici. R.	G51	0.062	-0.049	0.125	0.096	0.124	0.099	1.657	0.600
o-year-old Mortality R.	G52	0.000	0.000	0.000	0.000	0.000	0.000	-0.013	-0.012

Table 6.15 (Continued)

Effect	Index	Children Ever Born		Sterilization Status		Wife Sterilization Status		Husband Sterilization Status	
		Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
Total Fertility R.	G53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Female Divorce R.	G54	-0.005	-0.009	-0.003	-0.004	-0.003	-0.004	-0.033	0.062
Female College Grad. R.	G55	-0.068	0.240	-0.587	-0.579	-0.581	-0.567	0.571	1.676
For Mainlander Status	B6		B6	B6	B6	B6	B6	B6	B6
INTRCPT2	G60	-0.172 *	-0.205 *	-0.011	-0.013	-0.014	-0.016	0.337	0.265
Female Occup. Partici. R.	G61	0.108	0.246	0.076	0.147	0.085	0.162	-3.144	-3.026
o-year-old Mortality R.	G62	0.006	0.005	0.000	0.000	0.000	0.000	0.012	0.008
Total Fertility R.	G63	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001
Female Divorce R.	G64	-0.029	-0.018	0.009	0.011	0.006	0.007	0.529	0.494
Female College Grad. R.	G65	-0.961	-1.034	0.175	0.040	0.274	0.157	-2.404	-5.789
For Number of Dead Children	B7			B7	B7	B7	B7	B7	B7
INTRCPT2	G70			-0.028	-0.023	-0.019	-0.013	-6.936	-1.136
Female Occup. Partici. R.	G71			0.080	-0.008	0.084	0.008	0.505	-5.836
o-year-old Mortality R.	G72			0.000	0.000	0.000	0.000	-0.237	0.112
Total Fertility R.	G73			0.000	0.000	0.000	0.000	0.020	-0.003
Female Divorce R.	G74			0.028	0.026	0.027	0.026	2.411	-0.170
Female College Grad. R.	G75			0.418	0.829	0.510	0.905	27.731	-0.500
For Wife's Agricultural	B8			B8		B8		B8	
INTRCPT2	G80	0.165		0.237		0.244 *		-4.367	
Female Occup. Partici. R.	G81	-0.307		0.233		0.169		28.342	
o-year-old Mortality R.	G82	-0.013		-0.004		-0.004		0.161	
Total Fertility R.	G83	0.003		0.000		0.000		-0.017	
Female Divorce R.	G84	0.151		0.021		0.021		-0.697	
Female College Grad. R.	G85	-11.453		8.186		7.961		-141.842	
For Husband's Agri. Occup.	B8		B7		B8		B8		B8
INTRCPT2	G80		0.309 *		-0.011		-0.004		-4.899
Female Occup. Partici. R.	G81		-1.232		0.084		-0.019		12.892
o-year-old Mortality R.	G82		-0.001		0.000		-0.001		0.134
Total Fertility R.	G83		0.001		0.001		0.001		-0.001
Female Divorce R.	G84		0.042		0.003		0.008		-0.966
Female College Grad. R.	G85		-2.158		2.349		2.618		187.593
For Number of Boys	B9			B9	B9	B9	B9	B9	B9
INTRCPT2	G90			0.116 *	0.119 *	0.112 *	0.115 *	0.470 *	0.423
Female Occup. Partici. R.	G91			-0.006	-0.032	0.009	-0.013	-2.313	-2.789
o-year-old Mortality R.	G92			0.000	-0.001	0.000	0.000	-0.003	-0.010
Total Fertility R.	G93			0.000	0.000	0.000	0.000	0.001	0.002
Female Divorce R.	G94			-0.013 *	-0.012 *	-0.013 *	-0.011 *	-0.033	-0.032
Female College Grad. R.	G95			-0.014	0.034	-0.047	-0.028	4.451	6.988

Note: * $p<.05$

Source: TPIFP 1992, and EYRC 1992

women's CEB. Additionally, it has a negative effect on husband's sterilization status, which is also reasonable. The higher the Female Divorce Rate (G04) in a county, the lower the county's average expected log of women's CEB and the lower the couple's and wife's sterilization rate. These results agree with my hypothesis.

The main effects of the level-1 variables on the dependent variables are the G10, G20 to G90 coefficients. For CEB models in Table 6.15, several individual-level variables fail to pass the significance tests in this younger group. They are Owning Piano, Three-generation Familial Structure and Wife's Agricultural Occupation. This might denote that economic affluence, family control and traditional farming life style do not have enough influence on fertility for younger people in 1992. The other variables that pass the significance tests have the same relationships of coefficients with CEB as in Table 6.14. The odds ratio= $e^{-0.112}$ =0.89 is the main effect of wife's educational level on the log of children ever born. Comparing two women with a difference of one year in schooling, the woman with one more schooling year is predicted to have 11% less children ever born than the other woman. The γ_{20} odds ratio of Nowork Status is 1.17, so, after controlling for the other variables, women who do not work will have 17% more CEB than working women. The γ_{30} odds ratio of Wife's age is 1.11. The γ_{60} odds ratio of Mainlander is .84; hence, Mainlander women will have 16% less CEB than non-Mainlander women. The γ_{80} odds ratio of Husband's Agricultural Occupation is 1.36, so, after controlling for the other variables, the farming husband's wife will have 36% more CEB than the non-farming husband's wife.

For the G10, G20 to G110 coefficients of the three sterilization status models, the G10 of wife's and husband's educational level pass the significance test in the couple and wife models. All of them show negative effects. The G30 coefficient of wife's age shows a positive effect on couple and wife sterilization status. Regarding Agricultural Occupation status, only wife's Agricultural Occupation status (γ_{80}) in the wife sterilization status model are statistically significant. The coefficient is 0. 244 for wife's agricultural status, which means that a farming wife would have a log odds of having herself sterilized that is, 0.244 higher than a non-farming one. Its odds ratio of Wife's Agricultural Occupation is 1.28, so, after controlling for the other variables, farming women will have 28% more probability of herself being sterilized than non-farming women. Number of Boys still keeps its significant positive effect on couple and wife sterilization. It is compliant with the hypothetical expectation; when Taiwanese women have more boys, then they are more likely to end their fertility behavior by sterilization.

Regarding the cross-level interactions in Table 6.15, for CEB models, astonishingly, there is only one significant interaction effect. This is the γ_{32} coefficient of 0-year-old Mortality Rate, which has a positive influence on the slope of Wife age. This is not against the hypothesis, since the contextual effect of higher 0-year-old Mortality Rate should stimulate more fertility for security. Regarding the cross-level effects in the sterilization status models, the γ_{11} coefficient of Female Occupation Participation Rate has significantly constructive effect on the slope of wife's schooling level in couple and wife sterilization models. It suggests that for women living in a county with a higher Female Occupation Participation Rate, the negative effect of wife's schooling level on couple and wife sterilization tends to increases in comparison with women living in a county with a lower Female Occupation Participation Rate. This is fully supportive of the hypothesis.

The γ_{21} coefficient of Female Occupation Participation Rate has a significantly negative effect on the slope of no work status in the Model II of wife sterilization models. It suggests that for women living in a county with a higher Female Occupation Participation Rate, the positive effect of no-work status on couple and wife sterilization will be less than for those women living in a county with a lower Female Occupation Participation Rate, after controlling for the other variables. These associations are consistent with theoretical expectations regarding women's status. Especially, even regarding no-work status, women in a context of higher women's status can refuse to shoulder the sole responsibility for fertility control and can, therefore refuse sterilization. As in Table 6.14, the Female Divorce Rate still has a negative effect on the slope of Number of Boys, but the γ_{95} coefficient of Female College Graduation Rate fails to be significant. This is expected that Female Divorce Rate will act against the positive effect of son preference on women's sterilization.

The Discussion of Table 6.14 and Table 6.15, Taiwan Data

Generally, for the two groups of HGLM models of the 1992 Taiwan KAP data, Table 6.14 does not show many cross-level effects and, Table 6.15 shows less cross-level effects. Part of this may be because Taiwan counties show a fairly uniform and homogeneous level of development; the county thus may not be the optimal contextual unit for multilevel analysis, especially as regards the younger generation. Based onTable 6.10 for One-way ANOVA Models, it is also significant that the Taiwan models have a low amount of variance at the aggregate level.

Among the 17 significant cross-level effects, there are nine that run counter to the stated hypotheses. They are the interactions of Female Occupation Participation Rate with wife agricultural occupation status in wife sterilization model of Table 6.14, 0-year-old mortality rate with owning a piano in CEB model of Table 6.14, 0-year-old mortality rate with Mainlander status in couple and wife sterilization model of Table 6.14, Female, Divorce Rate with wife education in CEB model of Table 6.14, Female Divorce Rate with owning a piano in CEB model of Table 6.14, Female Divorce Rate with wife agricultural occupation status in CEB model of Table 6.14, Female College Graduation Rate with Nowork status in couple and wife sterilization model of Table 6.14, Female College Graduation Rate with number of boys in couple and wife sterilization model of Table 6.14, and Female College Graduation Rate with number of dead children in couple sterilization model of Table 6.14.

As stated earlier regarding the younger generation shown in Table 6.15, economic power, familial structure, and farming style seem to have lost most of their power to influence fertility behavior. Fricke and his associates (1994) also perceived this transition in the recent evolution of Taiwanese society. Nonetheless, level-1 wife's education still plays a significant role in CEB, couple and wife sterilization models in these two tables. Without doubt, women's education has a more comprehensive role in Taiwan than it does in China. In addition, Number of Boys has more significant effects on sterilizations than Number of Dead Children, which conforms with the findings of the logistic analysis, but does not agree with the finding in the survival analysis. In China, both variables show similar results. The prevalence of male sterilization in Taiwan is much less than in China; consequently, the poor analysis results for the husband sterilization models are not surprising. Regarding the level-2 effects, as in the data for China, among the five contextual variables, Total Fertility Rate does not have noticeable effects on these models. In the final chapter, I will further integrate the findings of this chapter and conclude with a discussion of their implications, including possible directions for future research.

CHAPTER VII

CONCLUSIONS AND DISCUSSION

Summary and Conclusion

China (People Republic of China, PRC) and Taiwan (Republic of China, ROC) separated in 1949 when the Communist Party took over control of the mainland, and the Capitalist Kuomintang Party withdrew to Taiwan, which Japan returned to China in 1945 after Japan's defeat in World War II, thereby ending its fifty-year occupation of the island. Subsequently, as described in Chapters II and III of this dissertation, mainland China and Taiwan experienced very similar trajectories of development regarding women's status and population transitions. Yet in these dissimilar political regimes these similar trajectories resulted from different underlying mechanisms. In China, policy promotion by a dictatorial party was a major force that pushed to have women eulogized as holding up "half of the sky" (Tuan 1989). In China, also, the lower fertility rate resulted in part from "direct and forceful government intervention" in family planning, as well as partly from social and economic development (Poston 1998). A somewhat different story unfolded in Taiwan. Chiang (2000) argued that the growth of women's status in Taiwan has inadvertently resulted from the island's general rise in socioeconomic vigor and from liberalizing the political arena. A dropping fertility rate in Taiwan resulted from mainly voluntary reductions in family size in response to social and economic development (Sun 1984; Feeney 1994; Poston 1998).

As stated in Chapter I, the specific purposes of this dissertation were (1) to ascertain through contextual analysis with HGLM methods the direct and the cross-level effects of province-level and county-level indices of women's status and development on fertility behaviors of individuals in China and Taiwan, (2) to examine with Robust, Poisson, logistic, and survival analyses the macro- and micro-level effects of women's status and family structure on the number of children ever born (CEB) and on sterilization status, and (3) to conduct a preliminary comparison of how women's status has affected fertility outcomes on both sides of the Taiwanese Strait.

The theoretical bases of this study are Demographic Transition Theory, the Economic/Sociological Synthesis of Easterlin, the New Home Economics of Gary Becker, and women's status theory. By investigating China, the author attempts to observe, especially at the contextual level, whether there is a disparity in empirical support for the Western perspective of socioeconomically based demographic transition versus the Asian perspective of planned demographic transition (Caldwell 1993). The main practical strategy of analysis focuses on the effects on fertility of women's education, women's employment, and family structure, as well as, in analysis of China's data, on the effects of intervention policy. Within this framework, individual data for Taiwan are from*1992 Seventh KAP (Knowledge, Attitude, and Practice of Contraception) Survey* (TPIFP 1992) among married women participating family planning and, for China, from the *1988 China Woman Fertility Survey* (SFPCC 1989). Macro-level data for Taiwan's county-level units are from the the *Taiwan-Fukien Demographic Fact Book 1992* for Taiwan (EYRC 1992); for China's provincial units, the data are from the *1990 China Population Census* for China (NBSC 1991).

With respect to the first purpose (identifying multi-level correlates of women's status and fertility behaviors), the analyses show that the contextual characteristics of province and county have demonstrable direct and interactive effects on individual women's fertility, as presented in Tables 6.11 through 6.15. Moreover, most of the effects tend to conform with the hypotheses proposed in Chapter V. For example, in Taiwan, women who do not work outside the home and who live in a county with higher female employment are less likely to use sterilization than her counterparts living a county with a lower rate of female occupation (see Table 6.14). Among China's rural population, women whose husbands work in an agricultural occupation and who also live in a province with a higher female divorce rate, have smaller numbers of children ever born (CEB) than women whose husbands also are farmers but live in a province with a lower female divorce rate (see Table 6.13). These findings highlight the value of sociological studies of micro-macro linkages to increase our understanding of how the social and economic characteristics of the contexts in which individuals live affect their behaviors. Without multi-level analysis, we could not obtain the precise and accurate representation of those relationships.

For the six contextual variables included in the multilevel analyses of province-level units in China and for the five variables used in the county-level analysis in Taiwan, I have summarized in Table 7.1 the significant results that have previously been shown in Tables 6.11 through 6.15. Total Fertility Rate (TFR) does not have apparent effects, because only once in the analyses for each data does the TFR show statistical significance. However, based on the caution of Hamilton (1992:92), multicollinearity may lead to neither the slope nor the intercept being individually distinguishable from zero. Examining the correlation matrix of Table 6.1 and Table 6.2**,** the correlation coefficient of TFR and Female Occupation Participation Rate is 0.51 for the China data, and there are three correlation coefficients with TFR that are more than or equal to 0.50 for the Taiwan data. These could be attributed to the poor performance of TFR for these two regimes. Hence, the direct and indirect effects of TFR are worthy of being examined in future research.

Most of the unexpected results (i.e., results counter to stated hypotheses) are associated with Female Divorce Rate and Female College Graduation Rate. All coefficients that did not support the hypotheses are coefficients of cross-level effect.

In China, three predictors demonstrated expected outcomes: Female Occupation Participation Rate, 0-year-old Mortality Rate, and One-Child Certificate Rate. In Taiwan, however, the first two variables showed inconsistent results. The third variable was not applicable to Taiwan.

For these contextual variables, cross-level effects on personal fertility behaviors were validated more often than direct effects were validated. For example, in Table 6.12, Female Occupation Participation Rate affects the slope of Three-generation Familial Structure on sterilization usage. I suppose that the contextual effect of the marital partners' mutually observing that women in close proximity to them are going out to work may influence each spouse's sterilization decision by way of the familial structure, so that sterilization is more often undertaken by husbands, rather than the husbands' viewing sterilization as solely the contraceptive responsibility of the wife. on the other hand, no significant effect is apparent for Female Occupation Participation Rate alone. In addition, Female Divorce Rate has a few significant cross-level effects but, confusingly, it too shows variable results. In future research, possible effects should not only be considered regarding the female divorce rate, but also for the ratio of female-male divorce rates. Without more detailed information about the contexts, interpretation is difficult regarding how and why these direct and interactive effects work. The empirical and quantitative analysis presented here, however, focuses attention on promising connections among an almost infinite number of possible relationships. The unexpected significant results among the cross-level effects offer guidance for future research.

As for verification of theories, Western demographic transition theory has principally relied on contextual variables that are indices of socioeconomic status. But the magnitude of the impact in China of government intervention is clearly demonstrated by the uniformly significant performance of the One-Child Certificate Rate variable. At the contextual level, Western demographic transition theory and Asian demographic transition theory both find support in this dissertation’s data on China’s population transition. Future studies should include more complete aggregate variables such as the size of local family planning budgets and expenditures, the quality and size of local family planning staff, and the objective evaluation of effectiveness of local family planning. In that way, we can identify more specifically the features of the governmental context that are most significant.

Regarding the second purpose of this study (i.e., to examine macro and micro effects of women’s status and family structure on CEB), in robust regression models in Table 6.3, three macro-level variables (Female Occupation Participation Rate, Female Divorce Rate, and Female College Graduation Rate) stand out as indicators of women's status at the aggregate level. Female Occupation Participation Rate does not have significant effects on fertility or sterilization behaviors at either the provincial level in China or the county level in Taiwan. Except for its relationship to male sterilization status in China, Female Divorce Rate demonstrates expected effects on both sides of the Strait. Female College Graduation Rate shows the expected relationship in Taiwan, but in China shows no significant effect on sterilization status and has a positive effect on the number of CEB. As mentioned in the review of literature in Chapter IV, that result is not surprising, because China is less developed than is Taiwan.

In the micro-level Poisson analyses, women’s educational level as an indicator of women's status is a good predictor of fertility behaviors in both China and Taiwan. All the results in my analyses in Table 6.4 and Table 6.5 support the stated hypotheses. The wife's educational level is a good predictor for decreased numbers of CEB in China and in Taiwan. The educational level of the husband follows the same pattern (see Table 6.4 and Table 6.5). These findings support the theories of New Home Economics and Women’s Status.

The logistic analyses show that women with higher educational levels are more likely to use contraceptive measures other than sterilization, which is the most radical and permanent method of contraception. But in both China and Taiwan, the wife’s

Table 7.1 Number of Significant Direct and Cross-level Effects of Contextual Variables on Individual Fertility Behavior in 1988 China and 1992 Taiwan.

	China			Taiwan		
	Number of Direct Effects Passing significance test	Number of Cross-level Effects Passing significance test	Fail to Fall within Hypotheses	Number of Direct Effects Passing significance test	Number of Cross-level Effects Passing significance test	Fail to Fall within Hypotheses
Female Occup. Partici. Rate	2	5	0	0	4	1
0-year-old Mortality Rate	3	6	0	4	3	2
Total Fertility Rate.	0	1	0	0	1	0
Female Divorce Rate	2	4	3	3	6	3
Female College Grad. Rate	0	2	2	2	3	3
One-Child Certificate Rate	3	3	0			
Total	10	21	5	9	17	9

Source: TPIFP 1992, EYRC 1992, SFPCC 1989 and NBSC 199

educational level has no significant effect on the probability of her husband's sterilization. The husband’s educational level affects dependent variables differently in China than in Taiwan. In Taiwan, more highly educated husbands are more likely to help their wives choose non-sterilization means of fertility control and are also more likely to undergo male sterilization. In China, however, more highly educated husbands are more likely to have wives who are sterilized, but the husband’s educational level is not significantly related to male sterilization (see Table 6.6 and Table 6.7).

Because of the poor classification of occupations in both data pools, analysis of women’s employment status was limited overall to the effect of traditional farming. In

Taiwan, however, I added a variable of no-work status, because many of the women in the Taiwanese data did not work outside the home. In both the macro and micro analyses, after controlling for other variables, women working in this traditional occupational style were hypothesized as more likely to have conservative fertility behavior than other non-farming women in Taiwan and China. In the Poisson Models, after controlling for other variables, results were as expected, with Taiwanese women who worked only inside the home showing a higher probability of self-reporting conservative attitudes about fertility and a higher probability of having a greater number of CEB. Identical results were significantly associated with the husband's having an agricultural occupation.

In the logistic analysis of sterilization status (Table 6.6 and Table 6.7), in Taiwan, a wife's farming is negatively associated with use of contraceptive measures other than sterilization; in the China's wife model, however, no such effect is observed. In Taiwan, the no-work status similarly showed no significant relationship with sterilization. In China, a husband who farms is more likely to have a wife who is sterilized, or is more likely to be sterilized himself. In Taiwan, however, husband's farming was not related at all to either his own or his wife's sterilization. At the micro level in both China and Taiwan, the two indices of women's status (educational level and work status) are related to fertility behaviors as expected.

In the survival analysis (see Table 6.8 and Table 6.9), parity was brought in as another interesting dimension of fertility analysis. In Taiwan, higher educational levels of wives or husbands are, for each of the three childbirth periods, significantly associated with lower probability (or risk) of proceeding to the next childbirth. In China, also, higher educational levels of wives and husbands are significantly related to greater probability of the first and second childbirths, but not the third. In China, agricultural-occupation status shows negative effects on the probability of having a first and a second childbirth, but is associated with greater probability of proceeding to a third childbirth. A similarly unexpected pattern appears in Taiwan's parity data: there, agricultural-occupation status shows a positive relationship with the hazard for the first birth, then fails to reach significance for the second birth, then again displays a positive relationship for the third birth. So, after controlling for other variables, we can say about the 1988 China fertility data and the 1992 Taiwan KAP data that when people engaged in a farming occupation have the second birth, they are more likely to have the third childbirth than are non-farming people. It is not true, though, that farmers are more likely than non-farmers to have to either the first childbirth or the second. Because survival analysis simultaneously models both time duration and event occurrence, these previously unreported and therefore unexpected findings emerge in this study and lend further credence to arguments mentioned in Chapter IV that the contextual vectors that mediate between women's status and reproductive choice are diverse and multidimensional.

The third purpose of this study was to conduct a preliminary comparison of the effect of women's status on fertility outcomes for China vis-à-vis Taiwan. Concerning employment status, first, because clear-cut occupational classification data were lacking, I focused on the traditional agricultural occupation, which is seen primarily in conjunction with rural households detached from other social organizations.

Consequently, people working in an agricultural occupation are less likely to be exposed to modern ideas such as gender equality, retirement management, and up-to-date contraceptive measures. Additionally, in Taiwan, persons in farming occupations do not participate in the public pension system like persons in other occupations. In China, the security previously offered by the commune system is no longer available since the demise of communes. So it is not difficult to understand that for security in their old age, farmers prefer more children. Similarly, it seems likely that because of limited information and resources in rural areas, sterilization for farmers is the most readily available and customary contraceptive measure when the farmers have attained their desired number of children (especially in view of its promotion by local and national family planning programs). The analysis of results comparing fertility behaviors of farming households in Taiwan and China reveals no noticeable difference between them. The general applicability of the results, however, for comparing the general populations of China and Taiwan is severely limited. That is true because in China most women are still engaged in farming (75%, as shown in Table 5.1). Using farming as an occupational classification, therefore, subsumes most of the women in China. Conversely, in Taiwan, a highly industrialized country, only 3% of women belong in this category. So in future study of women's employment status in Taiwan, a focus on paid employment other than farming should yield results more generally applicable to working women.

In the brief review thus far of the results of this study's six analyses, the expected associations of educational level with fertility and sterilization behaviors are more evident in Taiwan than in China. At the macro level, educational status in China is not associated with a smaller number of children ever born (CEB) nor, in macro-level and multi-level analyses, is it associated with any particular sterilization pattern. In contrast, Taiwan, a country in the ranks of the developed nations, has greater latitude to let women use their educational capital to manage their fertility and contraceptive lives. In Taiwan, the emerging population problems are the aging population and low fertility, rather than a fertility rate that needs to be curbed. Based on the latest statistics from the Taiwan Ministry of Interior, the 2003 total fertility rate (TFR) is 1.2, which is much lower than the replacement rate. As reported in the 2000 Women's Marriage, Fertility and Employment Survey (Census Bureau, Directorate-General of the Budget, Accounting and Statistics [DGBAS], Executive Yuan, Taiwan, R.O.C. 2000), for Taiwanese women the correlates of higher women's educational level are more years before marriage, lower (even zero) number of children desired, and a more advance maternal age at the time of first childbirth. The principal challenges that Taiwan faces concerning fertility are how to encourage married women to have more children in the current environment of higher living standards, higher costs of education, more prevalent nuclear-family structure, and higher costs of private daycare as a result of the shortage of public daycare services. of course, whether other contextual elements, such as employment, political participation, marital life, and the legislated protection of women's rights, may also (like educational level) have sanguine effects on fertility in Taiwan deserves attention by future researchers.

China is still a developing country. After Deng Xiaopeng's economic reforms that began during the 1980s, China's rapid economic growth has brought along with it extensive social development in other respects. For example, education is more accessible to women, as is documented in Chapter II. At the individual level (especially among younger women) the positive correlation of women's greater educational achievement with lower numbers of CEB and with fewer sterilizations of women is undeniably clear in this study (even though in multi-level analysis of the older two groups no such relationship is seen). For instance, in the multi-level analysis shown in Table 6.12, we see that the wives' educational level in the younger generation is significantly associated with lower incidence of wives' sterilization. In addition to the apparent catalytic effects of socioeconomic development and women's status in China, the silhouette of government interference is also prominent in China's fertility transition. The two individual-level variables dealing with family-planning policy (No One-child Certificate and Experience of Childbirth with Quota) are significantly correlated with fertility and sterilization outcomes. Moreover, sterilization is not only the most effective way of contraception, but it is routinely promoted by government officials, especially when localities have limited alternative contraceptive services. The second policy variable, One-Child Certificate Rate—a macro-level variable—likewise shows significant correlations in macro-level robust analysis and in multi-level analysis. These results again affirm that China's governmentally enforced fertility policy is a successful factor in influencing Chinese couples to conform their fertility and contraceptive behaviors to it.

It is worth noting that in Table 6.11, showing the results of the multi-level analysis for China, the Female College Graduation Rate has negative interaction effects (G35) with women’s education status on CEB but no such relationship is found in the Taiwan data. This suggests that in China, the context of women’s development status functions to ameliorate women with better education achievement in that milieu to lower their personal fertility behavior. Poston (1998) has stated that the decline in population in China can be attributed both to social and economic development and to governmental intervention. The empirical findings of this dissertation tell the same story.

Described as a brutal, coercive policy, the Chinese government’s family-planning policy carried out at local administrative levels has been criticized for violating human rights, depriving women of choices, and enforcing abortion and sterilization (Aird 1990). How to resolve the collision of individual rights with government demographic priorities should be based on the tenet that reproductive autonomy is a human right (Freedman and Isaacs 1993). In another words, the implementation of governmentally sponsored incentives and disincentives designed to influence personal childbearing decisions should incorporate an underlying commitment to trusting women, which is the fundamental principle of the women-centered approach. The purpose of such a strategy is to enable women to have the ability and the authority to take control over their reproductive lives, given that they already have access to adequate information and appropriate services. The National Population and Family Planning Commission of China, in fact, confronted this very issue. Under the heading, “Basic Views and Policies Regarding Population and Development,” on its website, the declaration is made, “[T]he principle of family planning is to combine governmental guidance with people's voluntariness; thereby the basic rights of every individual and every married couple are respected and protected, at the same time the couples are aware of their responsibilities and obligations."(SFPCC 2001) Xie (2000) explained that the demographic orientation of family planning in China is shifting toward a service-oriented approach, and that women-centered, quality service will be delivered to help the Chinese people have fewer births and create further wealth.

As for the other predictors investigated in this dissertation, familial structure has the expected positive effects on the number of CEB in Taiwan, but is not significantly correlated with sterilization behaviors. In China, contrary to expectation, three-generation familial structure has negative effects on number of CEB, an outcome that is difficult to interpret. Some empirical studies have, however, pointed out that the lack of living space is a constraining factor on the size of Chinese families (Guo 1996). Also, the possibility the outcome resulted from inaccurate data sources or from inaccurate manipulation of the data cannot be entirely dismissed. Overall, traditional Chinese family values remain influential in Taiwanese society. They are, however, losing their impact upon the younger generation, as seen in the multi-level analysis in Table 6.15, where it fails to pass the test of showing any significant relationship. Regarding son preference, in logistic analysis it is clear that the number of boys has a predictable effect on whether Chinese and Taiwanese use sterilization to bring about permanent contraception or proceed to the second and third childbirth. Because the numbers of children were so seriously limited in China, the number of dead children shows significant effects in all of China's analyses, but in Taiwan's analyses the effects of this variable are weaker.

Owning a piano, an indicator of wealth in Taiwan, presents a more complicated picture. In survival analysis, families who own a piano are more likely to have a first childbirth, but not more likely to have more children. In Poisson analysis, also, they are not likely to have a greater number of CEB. They are also more likely to have sterilization to implement fertility control. The picture about the relationship between wealth and fertility we get from the analyses in Taiwan is similar to the explanation of Mueller and Short (1983). They argued that the relation is inconclusive because higher incomes or greater wealth may lead in various ways to a change in tastes away from children and toward competing for material goods, even though such families can well afford to have more children. Along ethnic dimensions, Han in China and Mainlanders in Taiwan have fewer CEB and higher sterilization frequencies for wives and husbands. In both China and Taiwan, without question, the wife's age is positively related to greater numbers of CEB. The positive relationship of wife's age with sterilization status, after controlling for other variables, only appears in the younger generation of China (see Table 6.12), which suggests that older Chinese women are less likely to have sterilization. In Taiwan, women's age positively correlates with sterilization usage for both wives and husbands. In China, the rural-locality variable has the expected positive effects on CEB and sterilization, but in the models of survival analysis it fails to show significant effects in the second and the third childbirth periods. Because of the high proportion of cases located in rural areas in China's dataset, in the multi-level analysis, both Table 6.11 (for the whole sample) and Table 6.13 (for the rural group) show similar results, in contrast with the results in Table 6.12 (for the younger group).

At the individual level, fertility decisions probably result from a very complex intersection of social, economic, and biological forces. In this dissertation, the empirical methods were selected for their efficiency and appropriateness for dealing with the specific features of the data being analyzed: Poisson regression, for the count data of CEB; logistic regression, for the dichotomous dependent variable of whether or not sterilization has occurred; and robust regression, for the small sample size of provincial and county units. Survival analysis was used to simultaneously handle interval duration and event occurrence for the next childbirth. Multi-level analyses by HGLM identified some of the direct and interactive contextual effects, with multi-level Poisson models for the count data of CEB, and multi-level Bernoulli models for binary outcomes of sterilization. The results of the multi-level contextual analysis of women's fertility behavior offer empirical verification that it is not only influenced by her personal characteristics, but also by contextual forces such as observing or imitating behaviors of surrounding people and engaging those people in communication. These kinds of contextual effects can strengthen or weaken the effects of her personal characteristics on fertility and contraceptive decisions.

Future Research Suggestions

A successful multilevel analysis involves several conditions, some of which are not fully met in this study because of limitations of the data. In order to carry out an effective multi-level analysis, first of all, selecting an appropriate contextual unit is necessary. The accurate specification of the context is crucial, so that researchers should seek to specify the smallest possible social unit that enables them to treat as negligible the heterogeneity within those units as regards institutional structures and values (Hammel 1990). As argued in Chapter VI, the poor results of cross-level effects in Table 6.15 may be attributable to the inappropriateness of the county as a unit for the younger cohort in Taiwan, which is a largely homogeneous, evenly-developed region. By contrast, except for Hainan province, most provinces in China are much bigger than Taiwan, and greater diversity within each province is therefore to be expected. No doubt, the province unit is a very rough contextual unit.

It follows that further research is needed to investigate the influence of the choice of a specific regional social context on the empirical outcome of the analysis. However, it is not easy to understand the processes through which context is related to individual action: the greatest barriers are met in trying to “systematically revise the different modalities with which the grouped variables are introduced into circular causation sequences between micro and macro” (Micheli 1991). The multilevel approach also requires a complex, specific survey design that can help researchers explore all possible contextual dimensions. Technically speaking, this means that survey designs must be more complicated in order to ensure the right sample size to study the hypothesized micro-macro relationships between phenomena. So, for example, the models of male sterilization in Table 6.10 generally have more contextual variance than other models, but because of uneven scarcity of occurrences of male sterilization in the contextual units of this study, the association between the predictors and the outcome variable cannot be fully established in the analyses in Tables 6.11 through 6.15.

Finally, in order to identify the underlying mechanisms and explicate more fully how contextual effects operate, researchers might need to go beyond the standard geographic descriptors of social contextualization and aim instead at gathering data that are more qualitative. Without question, the ultimate challenge for multi-level fertility research is to define an appropriate contextual unit that incorporates the specific differentiating features of both the country and the culture. For example, Hammel (1990, p. 467), claims that a “successful incorporation of anthropological concepts of culture into demographic explanation” requires careful ethnography that allows “comparative studies of relatively small social units, however large and complex may be the societies within which these are embedded.” Accordingly, for example, how long people live in the research contexts should be controlled, or data on his or her migration history should be collected. Moreover, as in Table 6.11, the γ64 coefficient of the cross-level effect of the Female Divorce Rate with Three Generation Familial Structure is positive, which is contrary to the hypothesis that areas with higher divorce rate represent high women’s status, thus a lower CEB would be expected. Judging from this result, whether people use divorce to avoid the limit of one-child-policy to gain more of an opportunity for a childbirth is an interesting topic in China. However, without ethnographical data, we can not properly address this query. Unfortunately, in this exploratory study, these kinds information were not available. As mentioned before, we need more relevantly detailed information for the contextual unit. This dissertation can, however, be deemed a preliminary roadmap for multi-level analysis in the field of fertility and women’s status.

From survival analysis that took into account both time duration and event occurrence, we see that the predictors showed their influence on different parities of childbirth. How the contextual effects work on the survival analysis results is worth consideration in future study; a multi-level hazard analysis needs to be conducted to provide more insights into this field.

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