Convergence towards Diversity?

Cohort Analysis of Fertility and Family Formation in South Korea

by

Sam Hyun Yoo

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Approved April 2015 by the
Graduate Supervisory Committee:

Sarah Hayford, chair
Victor Agadjanian
Scott Yabiku

ARIZONA STATE UNIVERSITY

May 2015

ABSTRACT

This dissertation explores changes in fertility and family formation in South Korea, a setting in which rapid demographic changes have taken place since the early twentieth century. Despite active debate and discussion among experts and policymakers, knowledge is still limited in regards to the country's significant demographic changes. I take advantage of Korean census samples data from 1966 to 2010, which span birth cohorts from pre- and early-transitional stages to post-transitional stages, which comprise the entry stage of the second demographic transition. From a cohort perspective, I use diverse demographic methods to analyze three different aspects of fertility and family formation—fertility differentials, marriage delay, and fertility concentration.

The findings illustrate how fertility and marriage patterns have changed over generations and range from a politically tumultuous period, which includes World War II, liberation, and the Korean War, to an advanced economic period. By and large, the three studies suggest that until 1960, fertility and family formation converged as per social norms and leadership guidelines. Then, marriage and childbearing behaviors began to diversify and variation by social groups increased for cohorts born during and after the 1960s. The phrase "convergence towards diversity" captures the reversal of demographic trends within the country. Taken together, this dissertation advances our understanding of how fertility and family formation have changed in South Korea, which has been on an intense demographic journey from pre-transitional fertility through very low fertility, and currently headed toward another destination.

DEDICATION

To my wife, Munjin Kim, and two daughters, Danby and Dahee

ACKNOWLEDGMENTS

First and foremost, I am grateful to my advisor and chair, Sarah Hayford, for the numerous hours she has dedicated to training and guiding me over the past six years. I was fortunate in having her as an advisor and truly enjoyed working with her and discussing demographic topics. The ways she solves academic problems and works with colleagues became a model that I would like to follow and has helped me to develop my own way.

I also want to thank my committee members for their guidance and support. Working with Victor Agadjanian, I was able to learn how to develop research ideas and conceptualize nuanced concepts. His great ardor for academic work and productivity inspired and motivated me. As a professor, researcher, and a father of two daughters, Scott Yabiku was a role model for me. His energy and positive attitude taught me to balance between work and family, especially when I struggled with unfamiliarity of child-rearing.

Outside of my committee, many faculty members and colleagues have also helped me in many aspects. I am grateful to faculty members, Jennifer Glick and David Schaefer for giving me an opportunity to work with them. Their work and experience expanded my research and helped me to explore relevant topics and methods. I highly appreciate my colleagues with whom I studied for their wisdom, humor, and encouragement that boosted my morale and research.

The idea of this dissertation was first conceived when I participated in the 2012 Young Scientist Summer Program (YSSP) at the International Institute of Applied System Analysis (IIASA), Laxenburg, Austria. I gratefully acknowledge the Nathan

Keyfitz fellowship, which funded me for the program. I also thank Bilal Barakat and Tomáš Sobotka for their help, comments, and discussions, which were truly beneficial for me. One of methods in this dissertation was inspired from the 2011 East-West Summer Seminar on Population, East-West Center, Mānoa, Hawaii. I would like to convey my appreciation to Minja K. Choe, Tomas Frejka, Robert Retherford, Ronald Rindfuss, and other participants. This dissertation also received support from the Office of the Vice-President for Research and Economic Affairs, the Graduate Research Support Program, and the Graduate College, Arizona State University.

Both my studies and the completion of this work would not have been conceivable without the support of my family. I am very grateful to my wife, Munjin, for her love, support, and encouragement during my studies. Having two babies and supporting my studies, she weathered well through the time that might be the hardest in her life. To my two daughters, Danby and Dahee, they were good motivation for my studies. I also thank my parents for always being supportive. Their endless support and sacrifices led me to where I am today. I also feel indebted to my parents–in–law for their thoughtful support and consideration, two older brothers and siblings–in–law for their understanding and encouragement. Finally, I would like to extend my appreciation to all of my teachers and friends who helped me through my long journey.

TABLE OF CONTENTS

CHAPTER Page

CHAPTER Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Across Europe and East Asia, fertility has dropped below replacement levels while marriage has simultaneously declined. Variation exists between countries in exact patterns, but the overall trend has been consistent in the past decades. The combination of (very) low fertility and the decline of marriage is one of the major features that characterize what demographers call the *Second Demographic Transition*. The second demographic transition was originally intended to explain the shared demographic changes in fertility, family, and partnership-related behaviors that have occurred in Western and Northern Europe since the 1960s (Lesthaeghe & van de Kaa, 1986). Despite debates about its ambiguity, the theory is widely accepted to describe similar changes in Southern and Eastern European countries and frequently used to describe demographic changes in the rest of world, particularly in East Asia. East Asian countries, including South Korea, share key forces that have caused low fertility and marriage decline, including, for example, extended education, an increase in women's social participation, postponement of marriage, and economic constraints.

One of the ongoing debates about the second demographic transition theory is whether the demographic trends observed in Europe will spread to other parts of the world. It might be naïve to expect that the European experience would be exactly replicated in other regions. Although classical demographic transition theory has been widely accepted, it has several flaws that have invited criticism. In particular, some of the theory's major assumptions have not always been satisfied. For instance, in a few places, mortality decline did not precede fertility decline, and economic development was not necessarily required for the onset of the demographic transition. Moreover, government support such as family-planning programs and unprecedented contagious diseases such as HIV/AIDS, which were not considered in the theory's initial form, often accelerate or delay fertility decline.

These transition theories should therefore be taken as a description of demographic ebb and flow. Since diverse backgrounds generate differences in demographic progress and outcomes, it is hard to conceive of a single predetermined pathway across various regions and contexts. Accordingly, the theories should consider distinct characteristics of regions and countries. For instance, even among countries that are well ahead in the second demographic transition, a few contradictory characteristics have been observed such as near replacement fertility in the U.S., a lower level of out-of-wedlock births in Southern Europe, and rapid shifts in fertility driven by economic constraints, rather than value changes, in former socialist states. The differences across European countries are substantial and deeply rooted in culture and history; thus, the eventual convergence of demographic characteristics will likely not occur in the near future.

Also, variation exists within countries, which is often stronger than variation across different countries. Diversity in the timing and sequencing of early life-course events is particularly pronounced. The sequential order of events such as home leaving, sexual onset, marriage, and childbearing is increasingly switched and mixed up and is often described as "de-standardization" of the transition to adulthood. In some parts of society, for example, non-traditional forms of family like cohabitation, non-marriage, and non-marital births are widely accepted, but in other societies marriage is still preferred as an ideal form. Taken all together, the "convergence toward diversity" as described by Billari and Wilson (2001), captures such trends and variations within and across countries.

Similar to European countries, East Asian countries have experienced low fertility and marriage decline, however, the demographic patterns have differed widely. Having achieved rapid economic growth, the countries in this region are more familiar with accepting innovative ideas and behaviors from others. For instance, the acceptance and expansion of contraceptive use and small family-size norms facilitated unprecedented fertility decline in this region. However, most parts of this region, including Japan, Taiwan, South Korea, and parts of China, have reached very low fertility—lower than any world region since the beginning of the twenty-first century. The greatest difference in these trends from Western countries is the absence of cohabitation, non-marriage, and out-of-wedlock births. Despite gradual increases and more tolerant attitudes, these behaviors are not as common as in European countries and the difference is substantial. Low fertility and marriage delay have also gradually spread through other countries in East and Southeast Asia. As non-traditional behaviors have begun to increase, diversity across social groups has increased within countries.

More studies need to be done to advance our understanding of the commonalities and differences within and across countries in terms of significance considering the high share of this region's population to the world population. Research on differences within countries is still inadequate and existing research is often not widely read outside of the country, probably due to language barriers. In particular, there is lack of research that encompasses entire or multiple stages of demographic change. As a result, comparative research is often limited to sharing key demographic measures and policy efforts across countries. In order to form comprehensive theories and discussion for this region, more diverse studies on attitudinal and behavioral changes, including diverse paths to adulthood, are required.

A cohort is a useful unit of analysis to understand social changes. A cohort shares diverse characteristics from socialization and education to life trajectories, and successive cohorts are differentiated by differences in education, historical experience, and different responses to social changes (Ryder, 1965). Although a cohort shares the same events coextensively, the impact of life courses may vary with age at the time of events. For instance, certain historical events such as economic recession and wars, which influence the development of values, attitudes, and behaviors, also distinguish corresponding cohorts from others. Although the interaction between period and cohort effects often makes it difficult to understand social change, these essentially compliment to each other.

Fertility and marriage, of course, are also influenced by such events and vary with birth cohorts. However, as fertility and marriage occur in a narrow range of ages, cohort study on timing of childbearing and marriage can be more useful for studying social changes with regard to fertility and marriage. Furthermore, educational attainment is basically considered a sort of cohort experience as people usually complete their education by their late teens or early 20s. As standardized schooling systems develop grades based on age, birth cohorts born in the same year share school curriculum, vast social norms, and historical backgrounds. In addition to that, period measures using synthetic cohorts are often distorted by rapid changes in behavioral timing (Bongaarts and Feeney, 1998). Thus, when considering the association between women's education and demographic behaviors such as fertility and marriage, cohort analysis is more appropriate than period analysis.

This dissertation explores changes in fertility and family formation in South Korea (just Korea hereafter), a setting in which rapid demographic changes have taken place since the early twentieth century. In recent decades, fertility has further declined well below the replacement level, and people have increasingly delayed marriage. Among experts and policymakers, there is active debate and discussion with regard to the causes and consequences of very low fertility within the country and across East and Southeast Asian countries. However, regional and country-specific circumstances make it more complicated and policy efforts to raise fertility have not yet shown any meaningful results. As a result, our knowledge remains limited in terms of the significant demographic changes in the country. Literature tends to focus on periodic changes and evaluating policy effects and therefore cohort perspectives that can provide a big picture on the direction of change are rare in this region.

In this dissertation, I investigate how variations in fertility and family formation within the country have changed over a wide range of cohorts that have seen rapid demographic changes. The study consists of three different but closely related papers about fertility differentials, postponement and recuperation of marriage, and reproductive concentration. In the first paper of this dissertation (Chapter 2), I examine the changing pattern of educational differentials in completed cohort fertility and the relative contribution of women's educational attainment to that change. The second paper (Chapter 3) investigates how postponement and recuperation of marriage differs by level of education. Given that most births occur within marital unions in South Korea, variation in marriage timing directly affects fertility. The third and last paper (Chapter 4) explores how fertility concentration has changed and explores its association with level of education.

South Korea, like other East Asian countries such as Japan and Taiwan, is well known for rapid fertility decline accompanied by successful economic growth. During the last half of the twentieth century, the country has achieved a rapid fertility decline and marked improvements in women's educational attainment. Total fertility rate (TFR) in Korea was around 6.0 in 1960 but gradually declined and reached replacement levels in the early 1980s. Fertility further declined and finally reached TFR of 1.3 or below, the lowest-low fertility, in the early 2000s. Since then, the country has maintained a very low fertility rate. The country is considered notable for its successful family-planning program, which was launched in 1962. The family-planning program accelerated the fall of fertility by providing free birth control and incentives for small-sized families. However, as the decline continued, the population control policy was officially withdrawn in 1996, and finally changed into pro-natalist policy in 2006 (Lee, 2009). In the same period, the patterns of marriage also changed from arranged marriages to spousal choice (love marriages) and from early marriage to late marriage. Divorce rates began to increase and the timing of marriage has further delayed in recent years but universal marriage has still stayed strong as many women do eventually marry. The rapid social and demographic changes in the country provide a useful venue to study how the transitions of childbearing and marriage have occurred across the social strata.

This dissertation advances our understanding of the association between women's education and fertility-related behaviors. In many societies, women's education is negatively associated with fertility and marriage. A few studies report that the negative association becomes insignificant or reversed in Scandinavian countries, where most advanced gender equity has been achieved. Long-term analyses of this association in completely different settings illuminate how it has intensely transitioned from high to low birth rates. These analyses also offer an opportunity to test whether the insignificant negative association or reversal in prior studies are due to regional specific settings, which might appear only in countries that have achieved a high level of gender equity. The association between women's education and fertility also has important implications for countries seeking a decline in fertility, when they decide how to allocate efficiently among limited areas.

This dissertation also improves our understanding of how different social groups react to demographic changes and the spread of behavior from one segment to another. As Coale (1973) suggested, innovative norms and behaviors expand from one group to another depending on "readiness," "willingness," and "ability." Readiness indicates a cost-benefit scheme, that is, whether innovative behaviors provide some advantages; willingness indicates whether actors can accept behaviors after considering social prejudice and traditions; and ability indicates whether actors actually practice it. In the past, population pressure raised the demand for birth control (readiness) and national campaigns and family-planning programs lowered the barrier to entry (willingness). Distribution of free birth control methods improved access to contraceptive use (ability), which then resulted in a rapid diffusion of contraceptive use and a small family-size norm. It would be interesting to learn how other non-traditional behaviors, such as childlessness and non-marriage, transfer from one segment of society to another.

Historical patterns of childbearing and marriage not only expand our knowledge of demography in this region but also add more narrative to the discussion on the second demographic transition. The second demographic transition already shows diversity in Europe. For instance, relatively high fertility and cohabitation in Scandinavian countries contrasts with population trends in Southern European countries like Italy and Spain. Diversity in Central and Eastern European countries can be regarded as another pattern (Sobotka, 2008). East Asian countries have several salient features, such as the absence of cohabitation and the attachment of childbearing to marriage, which are distinct from other regions. Studies on the second demographic transition in East Asia enrich our knowledge about the diverse pattern of this transition and advance our understanding of commonalities and differences with European counterparts.

Research on long-term trends in fertility and family change inevitably requires longitudinal or repeated cross-sectional data that cover the corresponding scope, which are difficult to obtain. In 2012, Korean census samples data between 1960 and 2010 became available and provided a way to study these long-term dynamics. Population censuses have been conducted in Korea almost every five years since 1925, but early censuses are not available except for descriptive statistics. However, the newly released censuses provide a rare opportunity to analyze long-term demographic trends that go back half a century and would go back even further if cohort analyses are used. The Korean census data, which are known to be of high quality, include retrospective information about respondents' number of children and age at first marriage, as well as basic demographics such as age, sex, and highest levels of education. Taking advantage of this data, which is not always available in Korea or other East Asian countries, I conducted a demographic analysis of long-term trends in fertility and family and how these trends differ by women's levels of education.

The first paper investigates fertility differentials by women's level of education and discusses the contribution of educational expansion to a decline in fertility. Although educational effects on fertility vary, few studies have tested the dynamic changes of the association between women's education and fertility. The frequent negative association between women's education and fertility also raises the question of whether the expansion in women's educational attainment is largely responsible for the rapid decline in fertility. Building on two competing hypotheses, the *leader-follower* model and the *permanent difference* model, I document how fertility differentials have developed over the fertility transition. Demographic decomposition techniques can be used to test the relative contribution of compositional change in women's educational attainment to fertility decline.

In the second paper, I explore *postponement* and *recuperation* in marriage. In Korea, delaying marriage has been increasing for a long time while remaining single is still rare, which is in stark contrast with prevailing cohabitation in European countries and the U.S. I essentially test whether or not delay of marriage is made up later at the aggregate level, and if so, how quickly. This can explain not only the discrepancy, but can also provide important clues about the changing direction of marriage patterns, whether the delay is voluntary, and how these patterns could change in the near future. Using data on age at the first marriage, I construct a marriage schedule and compare it across cohorts and determine whether it advances or lags behind a prior cohort. The cohort analysis on marriage *postponement* and *recuperation* illuminates the variations of marriage delay within Korea and across other countries.

The last paper explores *fertility concentration*, the extent to which childbearing is unequally distributed in a homogeneous group of women. In the context of low fertility such as in Korea, the rise in childlessness in a group of women can cause unequal parity distribution, which probably leans towards disadvantaged women given the negative association between education and social status. This in turn can aggregate inequality in childrearing, which requires substantial resources, such as time, money, and effort. The mixed results on the association between the concentration and level of fertility in the existing literature also point to the need for additional empirical studies that cover the long-term transition from high to low fertility. I employ three measures of fertility concentration and evaluate merits and demerits. Changes in fertility concentration and its association with women's level of education provide new insights into how parity distribution has developed during the fertility transition. Taken together, these papers advance our understanding of how fertility and family formation have changed in the country, which has been on an intense demographic journey from pre-transitional fertility to very low fertility and toward another destination.

CHAPTER 2

EDUCATIONAL DIFFERENTIALS IN COHORT FERTILITY

Introduction

Women's education is usually associated with lower fertility at both the population and the individual levels (Bongaarts, 2003; Caldwell, 1982; Castro Martín, 1995; Cochrane, 1979; Jeffery & Basu, 1996; Jejeebhoy, 1995). However, the empirical association between *changes* in educational levels and *changes* in fertility rates at the population level is more complex. Educational change is associated with a range of economic and social changes which can alter the link between education and childbearing and/or the intensity of the link. As a result, although rising education generally leads to falling birth rates, the importance of educational trends varies. For instance, compositional change in education levels was found to account for 70% of the decline in fertility in Brazil between the 1935–1939 and 1951–1953 birth cohorts (Lam & Duryea, 1999), but only about one-third of the decline in fertility between 1980 and 2000 in Iran (Abbasi-Shavazi et al., 2008). The impact of educational change likely depends on the starting levels of education and fertility, as well as other contextual factors. Despite the theoretical importance of education as a contributing factor in the fertility transition, there have been relatively few longitudinal studies on education and fertility.

In this article, I use census data from South Korea to analyze changing associations between education and fertility, and look at how compositional changes in education contributed to the decline in fertility across the transition from a high to a lowest-low level. South Korea (hereafter Korea) experienced one of the fastest fertility declines in the world. The Korean total fertility rate was 6.0 in the 1960s, but it had plummeted to sub-replacement levels by 1983 (Statistics Korea, 2015). It took Korea less than 25 years to go from a pre-transitional stage to sub-replacement levels of fertility. In England, by contrast, this process took almost 130 years. Over that period, there were marked improvements in women's education. The college entrance rate among female high school graduates was 22.2% in 1980, but had reached nearly 80% by the late 2000s (Statistics Korea, 2010). Among the 1960 birth cohort, the proportion of women who had graduated from high school was negligible; but among the 1970 birth cohort, the share was more than 95%. The combination of a dramatic decline in fertility and a rapid increase in women's education makes the country an ideal case for studying this relationship during the fertility transition. Given the general association between fertility and education, we can hypothesize that the expansion of women's education was a major factor that contributed to the rapid transition from high to low fertility rates in Korea.

In this paper, I explore educational differentials in fertility and the changes over the course of the fertility transition in Korea. I briefly review theories on these differences by educational level and describe the Korean fertility transition. In the results section, I first display the trend of educational differentials in completed cohort fertility among women born between 1926 and 1970, and then examine the association between changes in fertility and in the composition of women's educational attainment levels. I also analyze the education-specific pattern of falling fertility over the transition. The key findings and their implications are discussed in the final section. Throughout this paper, I utilize completed cohort fertility to measure fertility instead of the period total fertility rate (TFR), which is often distorted or underestimated in places like Korea, where ages at childbearing change rapidly (Bongaarts & Feeney, 1998). This paper contributes to the literature on the association between women's education and fertility, and has implications for population policies in both developing and developed countries.

Educational differentials in fertility over the fertility transition

Despite long interest in the association between education and fertility, few theories on how educational differentials change over time have not yet been established. Bongaarts (2003) summarized the changes in educational differentials over different stages of the fertility transition, and suggested two theoretical models: (1) the "leader-follower" model and (2) the "permanent difference" model. Cleland (2002) also described the first as a "temporal model." According to the leader-follower model, fertility declines among highly educated women, and then less educated women follow their example. As the fertility decline begins, the gap in fertility widens between the higher and lower educational groups. These educational differentials then diminish as the transition progresses. Due to the staggered diffusion process, fertility behaviors gradually become similar across educational groups. Thus, fertility differentials by level of education are considered transient in this model (Cleland, 2002). The underlying assumption is that innovations such as the norm of a small family size and the use of birth control emerge among an elite group and then are diffused across the social strata.

In contrast, the *permanent-difference* model posits that educational differentials remain significant throughout the transition. This model, which builds on the microeconomic perspective that fertility is influenced by socioeconomic conditions (e.g., Becker, 1981), sees the fertility decline as an adaptation to changes in the economic and the social structures (Carlsson, 1966; Davis, 1945; Notestein, 1953). In this model, falling fertility is largely attributable to socioeconomic changes. A rise in educational attainment directly contributes to a fertility decline when the negative association between fertility and education remains constant. As a result, the fertility differentials by education persist at the end of the transition, even though the overall fertility rate decreases while the overall level of education increases.

The two models described above are essentially hypothetical and represent extreme cases. In reality, most cases fall between these two extremes because education is not only a primary determinant of fertility; it also functions as a pathway for the transmission of social norms and behaviors. The ways in which education influences fertility are so numerous (see Cleland, 2002 for a comprehensive review) that structural effects alone cannot explain contemporary fertility decline. For the same reason, the indirect educational effects on fertility may be much greater than expected (Caldwell 1980). The literature also suggests that any efforts to explain the decline in fertility over the course of the transition should take into account both structural and diffusion effects (Bras, 2014; Casterline, 2001; Cleland, 2001). Interestingly, scholars disagree about which model is empirically supported and how the fertility differentials end (James, Skirbekk, & Van Bavel, 2012; Jeffery & Basu, 1996; Lutz & Goujon, 2001). For instance, Cleland (2002) argued that in most societies, fertility differentials by education should shrink over time and converge at the end of the transition. He thus favored the leader-follower model (the "temporal" model in his terminology). By contrast, Bongaarts (2003), concluded based on his own analysis that the permanent-difference model is more supported because fertility differentials by education usually remain significant even in post-transitional countries.

These theoretical considerations regarding the changes in educational differentials in fertility have, however, rarely been tested. While the research described above examined several countries in late- and post-transitional phases, these studies focused primarily on less developed countries and relied on period measures of fertility (Bongaarts, 2003, 2010; Cleland, 2002). The mixed conclusions of these scholars may be attributable to the lack of evidence of a pattern of fertility differentials over the entire course of the transition, especially in the post-transitional phases. The literature has suggested that different patterns of fertility differentials appear in different phases of the transition. For instance, despite the inverse relationship between fertility and education, the size of fertility differentials by education tends to decline in late-transitional societies. (Bongaarts, 2010; Castro Martín 1995; Chackiel & Schkolnik, 1996; Shapiro, 2012). Similarly, Skirbekk (2008) found that fertility differentials across social strata become smaller as fertility gets closer to replacement level, although women's education has historically had a negative relationship with fertility.

Fertility differentials by education may vary in developed countries. For instance, in Nordic countries the inverse association between fertility and level of education has substantially weakened among recent cohorts (Kravdal & Rindfuss, 2008), and is often reversed when the age at childbearing is controlled for (Andersson et al., 2009). The evidence from Nordic countries contradicts the permanent-difference hypothesis, and also clearly demonstrates that the existing theory is insufficient to cover all kinds of educational differentials in fertility. Prior research seems to have overlooked the new demographic changes that occur in countries in the post-transitional stages, or in the "Second Demographic Transition" (Lesthaeghe, 2010; Lesthaeghe & van de Kaa, 1986).

As period fertility rates drop below the replacement level, the fertility differences by level of education decrease in absolute value. Contraceptives, which are used to explain fertility differentials by social strata, are readily available in most developed countries. However, economic recession and labor market insecurity tend to prevent young women from having large families. As a result, the fertility differentials by level of education in developed countries may be marginal or smaller than previous studies have predicted.

It is not clear whether the negative association between education and fertility diminishes or becomes reversed in the late and post-transitional stages, but it is apparent that the intensity of the association changes over the fertility transition. The dynamic features of this association have so far been underexplored. In this paper, I provide empirical evidence on the dynamic changes of fertility differentials by level of education using data covering the entire period of transition from well above replacement level to well below replacement level. I assess the contribution of changes in women's educational attainment to changes in completed fertility, and demonstrate how the trend toward having fewer children was transmitted across levels of education.

The fertility transition in South Korea

As the fertility transition in Korea has been described elsewhere (e.g., Kim and Kim 2004), I will outline it only briefly here. The fertility decline in Korea can be divided into three stages: a pre-transitional stage before the 1960s, a fertility transition between 1960 and 1985, and a post-transitional stage since 1985. Figure 2-1 depicts the total fertility rate in Korea between 1970 and 2010. Fertility in Korea did not decline until the early 1960s, and during that period the total fertility rate (TFR) remained at around 6.0 or above. However, the TFR increased somewhat in the late 1950s during the baby boom following the Korean War (1950–1953). International aid, which included the provision of antibiotics during and after the war, significantly reduced mortality, especially among infants and children. Factors such as an increase in population density in urban areas due to an inflow of war refugees, extreme poverty, and uncertain political situations caused by the Korean War drove young urban couples to limit their family size, fueled the demand for contraceptives (Kwon, 2001). Meanwhile, in the two decades after free, compulsory primary education was introduced in 1954, illiteracy was largely eradicated. (Kim, 2002).

The fertility decline started at the beginning of the 1960s. Viewing rapid population growth as a serious barrier to economic growth, the Korean government launched the National Family Planning Program in 1962 as a part of an economic development plan (for details, see Choe & Park, 2006; Kwon, 2001). The gross domestic product (GDP) per capita grew rapidly from $92 in 1961 to $1,674 in 1980 (The World Bank, 2013). The aims of the family planning program were to reduce the desired family size and to promote modern contraceptive use, especially among specific groups of the population. The program's early focus was on reducing fertility rates among women in rural areas, where fertility was the highest and access to birth control was limited. The program was later extended to reach the poor and the factory workers in urban areas (Kwon, 2001; Park et al., 1976). During this period, induced abortions were also widely performed, particularly among urban residents (Hong & Watson, 1972). In the 1970s, the government used incentives to encourage a two-child family norm, such as a tax deduction and benefits for public housing for couples with one or two children (Kwon, 2001).

At the same time, education about population growth was incorporated into secondary school curricula. Another factor that contributed to the fertility decline was mass internal migration from rural areas to cities. This movement was associated with rapid urbanization and industrialization, and tended to discourage childbearing as migrants struggled to adapt to city life (Lee & Farber, 1984). In the 1960s and 1970s, the proportion of contraceptive users among married women quickly increased, from 16% in 1965 to 44% in 1976 (Kwon, 2001: 47). The family planning program was successful, as slogans such as “Have fewer children and bring them up well” and “Stop at two regardless of sex” were well received by the general public. At the same time, access to secondary school education was expanding rapidly, and opportunities to pursue higher education were growing at a moderate pace (Kim, 2002).

The period TFR reached the below-replacement level in 1983, and the period between 1980 and 1985 is often regarded as being the threshold for the post-transitional stage characterized by low fertility (Jun, 2005; Kim, 2005). Rapid economic growth continued as GDP per capita exceeded $2,000 in 1983 and reached $11,347 in 2000 (The World Bank, 2013). In the early 1980s, the pace of fertility decline began to slow. Despite having achieved a below-replacement level of fertility, the government maintained the family planning program; encouraging families to have fewer children and seeking to mitigate son preference, partly out of fear that there would be an absolute increase in the population as the large young cohorts entered their primary childbearing ages (Lee, 2009). Thus, government policies continued to promote sterilization and provide incentives for restricting family size until the late 1980s. The sustained decline in period fertility rates finally caused the government to abandon the program in the late

1980s, leaving contraceptive distribution to the private and commercial sectors. Meanwhile, unbalanced sex ratios at birth and selective abortions emerged in the 1990s after new techniques for detecting the sex of the fetus were introduced (Larsen, Chung, & Das Gupta 1998). In 1996, the government officially adopted a new population policy with an emphasis on reproductive health care services.

In 2001, the Korean period TFR reached 1.3, the lowest-low level of fertility as defined by Kohler and colleagues (2002). Since the early 1980s, access to higher education had expanded rapidly for both men and women, and women's levels of participation in social activities and labor have increased. More crucially, the Asian economic crisis in 1997 changed the paradigm on marriage and childbearing and augured a further decline in fertility (Kim, 2007). The combination of changes in the status of women, growing economic insecurity, and insufficient childcare options led Koreans to delay marriage and childbearing (Jun, 2005; Kim, 2005; Suzuki, 2005). In 2003 the Korean government finally phased out the family planning program, which was by then more than 40 years old. A few years later, they adopted a set of pro-natalistic policies aimed at helping the country prepare for a period of aging. These policies are described in the First Basic Planning for Low Fertility and Aged Society 2006–2010, published in 2006 (Lee, 2009). Despite this shift, Korean fertility is still under the lowest-low level, with a TFR of 1.19 in 2013 (Statistics Korea, 2014).

Data and Methods

Data and measures. This study relies on a series of sample data from the Korean Population and Household Census (hereafter, Korean census) between 1970 and 2010. The Korean census is conducted every five years by Statistics Korea. The census usually contains a short survey questionnaire on households and individuals, and in most cases includes a question on the number of children ever born. For my analysis, I decided to use questionnaires from seven of the nine censuses conducted between 1970 and 2010 (the census data for 1980 and 1995 do not contain pertinent information). Thus, the sample data were drawn from the censuses of 1970, 1975, 1985, 1990, 2000, 2005, and 2010.

I compute completed cohort fertility by averaging the children ever born to women aged 40–44. As in prior research (e.g., Frejka, Jones, & Sardon, 2010), I consider ages 40–44 as the end of women's reproductive period. This age range was chosen for three main reasons: first, it reflects the census interval of five years; second, using ages 40–44 allowed me to include more recent birth cohorts in the analysis; and third, because the proportion of births to women age 45 and older is very small, the level of completed fertility does not change significantly when women are measured at ages 45–49 or 50–54.[1] For the 1980 and 1995 censuses, in which the question of children ever born was omitted, the corresponding birth cohorts were selected at ages 45–49 from the censuses of 1985 and 2000, respectively. All of the information, including the number of children and educational attainment, is measured at ages 40–44 unless otherwise specified. The questionnaire regarding the number of children ever born is retrospective, which means that the information provided may be inaccurate due to memory lapses or a failure to

[1] Based on the data analyzed in this paper, for example, the computed completed fertility (CF) for the 1960 birth cohort is 1.89, which is not far from the CF of 1.98 found when ages 50–54 are used for the end of women's reproductive years.

report children who died (Murphy, 2009; Ní Bhrolcháin, Beaujouan, & Murphy, 2011). In light of these concerns about the under-enumeration of children and selection caused by mortality differentials, responses from women over age 50 were excluded from the analysis. The sample size for each birth cohort ranges from a minimum of 1,389 to a maximum of 4,289.

The educational attainment of the respondents was measured using six categories: incomplete primary education, completed primary education, completed lower-secondary education, completed upper-secondary education, some college, and a bachelor's degree or higher. These categories are designed to capture the rapid educational transition in Korea, including the dramatic improvements in female education.

Like other social surveys in Korea, the census questionnaire asks only ever-married women about their pregnancy and birth histories. As a result, information on children born to women who have never been married is not available. I assumed that all of the women who had never been married by age 40–44 were childless because nonmarital births are rare in Korea, and marriage is still nearly universal for women by the time they reach the end of their reproductive period (Jones & Gubhaju, 2009). Even though the proportion of nonmarital births to all births was less than 1% in the 1960s and slightly increased to 2.1% by 2012, nomarital births are still uncommon (Statistical Korea, 2015). In addition, the data analyzed here suggest that approximately 98% of women born between 1926 and 1970 were married by the ages of 40 to 44. There are also 187 cases with missing values for the number of children among ever-married women aged 40–44. Because marriage and childbearing are virtually universal in Korea, childlessness may be considered shameful, and a non-response may be a way of avoiding a report of childlessness.[2] Based on the assumption that the majority of the missing cases represent a non-response or avoidance by childless women at the end of their reproductive years, I classified those women as childless, and included them in my analysis in order to offset a possible underestimation of childless women. The number of these women is negligible, and their inclusion has a minimal effect on the results. Cases in which the educational attainment or the marital status were missing are simply omitted here because they made up less than 0.1% of the total sample size, and no regular pattern was found.

Methods and strategy. The analysis presented here is composed of three parts. First, I review educational differentials in completed fertility over 45 single-year birth cohorts. As my interest is in fertility differences across educational groups, completed cohort fertility can be expressed as a function of education-specific completed fertility and the composition of educational attainment. Because we consider only women at the end of their reproductive periods, age is not required in this formula. Education-specific completed fertility rates are measured for every five-year birth cohort for women born between 1926 and 1970. The trends in education-specific completed fertility rates can be used to help us determine whether the pattern is closer to the *leader-follower* model or to the *permanent difference* model.

---

[2] To confirm, I checked household information for the missing cases. Of those cases, around 76% had no children living in the household. Approximately three-quarters of the cases with missing data in the CEB may be attributable to ever-married women with no children.

Second, I utilize a demographic-decomposition technique. This technique can be used to compare demographic measures between two populations or the same population between two different times, and to separate the effect of changing a single factor from other effects (Das Gupta, 1993; Romo, 2003). In this paper, I isolate the effects of fertility rates (*rate effects*) from those of educational composition (*composition effects*). After specifying that completed cohort fertility for a birth cohort equals the sum—as *i* goes to *j* (the number of educational groups)—of the education-specific fertility rate multiplied by the proportion of the corresponding educational group, the difference in completed fertility between the two birth cohorts is decomposed into *change* in the rates of completed fertility and *change* in the composition of educational attainment as follows:

$$CF^a = \sum_i^j (r_i^a \cdot p_i^a) \tag{1}$$

$$\Delta CF = CF^a - CF^b = \sum_i^j (r_i^a \cdot p_i^a) - \sum_i^j \left(r_i^b \cdot p_i^b\right) \tag{2}$$

In this equation, CFa represents the completed cohort fertility for the birth cohort a, ΔCF is the change in completed cohort fertility between birth cohort *a* and *b*, i is the educational-level index, j is the number of educational levels, ria is the completed fertility rate of group i for the birth cohort *a*, and p_i^a is the proportion of group i for the birth cohort a.

If we have two populations, we can evaluate the effect of a single factor on a standard population, which is acquired by averaging the other factor across both populations. However, the standardizing process is much more complicated when we have multiple populations. Das Gupta (1993) suggested a useful way to standardize demographic measures for multiple populations. His technique has frequently been used in prior research, particularly when demographic trends have been analyzed (DeLeone, Lichter, & Strawderman, 2009; Hayford 2005; Smith, Morgan, & Koropeckyj-Cox, 1996). Having nine different birth cohorts, I employ Das Gupta's method to standardize completed fertility for multiple populations, and then break it down into six educational categories.[3]

Finally, I use parity progression ratios to show the pattern of declining fertility across levels of education. A parity progression ratio is a demographic measure used to capture the proportion of women who have another child (parity $k + 1$) from a certain number of children (parity k) (Preston, Heuveline, & Guillot, 2001: 101–106). Parity progression ratios are simply parity-specific birth probabilities. Period parity progression ratios have often been used in prior research on fertility change (e.g., Feeney, 1991). However, I use cohort parity progression ratios instead of period ratios, and further expand my calculation by the level of educational attainment in order to compare the trend of falling fertility across social strata:

$$PPR_{(k,k+1)} = \frac{Number\ of\ women\ at\ parity\ k{+}1\ or\ more}{Number\ of\ women\ at\ parity\ k\ or\ more}. \quad (3)$$

I compute cohort parity progression ratios for six educational groups and compare the patterns. After parity progression ratios are used to reveal the detailed pattern of fertility decline by birth parity, we are better able to compare changes in fertility

[3] The process of decomposing differences for polytomous-categorical variables is explained in Chevan and Sutherland (2009).

outcomes across educational groups, and thus to discern the evolutionary pattern of educational differentials in fertility. Because of the small sample size for each educational group, especially among the oldest and youngest birth cohorts, I use a five-year birth cohort instead of a single-year cohort for the decomposition and the parity progression ratios.

Results

Completed fertility and educational differentials. Figure 2-2 shows trends in educational attainment among women aged 40–44 for the corresponding 1926–1970 birth cohorts. The figure illustrates the marked expansion in women's educational attainment between the 1926 and 1970 birth cohorts. For example, less than 5% of women born in 1926 had more than an upper-secondary education, compared with nearly 95% of women born in 1970. Similarly, the share of women who achieved some type of higher education increased from less than 1% to 37% between two birth cohorts.

Figure 2-3 illustrates the completed cohort fertility and educational differentials for women born between 1926 and 1970. There is a clear downward trend without temporal fluctuations in completed fertility among all of the cohorts. The average number of children per woman decreased by more than one-third over the 45 birth cohorts, from 5.51 for the 1926 cohort to 1.73 for the 1970 cohort. The below-replacement level was reached when the 1957 birth cohort had 1.98 births per woman. The pace of the decline in completed fertility moderated after this point, but continued through to the most recent cohort. As was mentioned previously, the period TFR of Korea fell to replacement level between 1980 and 1985 (Jun, 2005; Kim, 2005). For the 1957 cohort of women, who would have started having children soon after marrying, the median age at first marriage was 23 (Appendix 2-A). If we assume that the primary childbearing ages of the 1957 were 23–27, we can see that there was a shift in both the cohort and the period fertility measures at this time, which was the point in the fertility transition at which Korea started moving toward low fertility. The uninterrupted downward trend in completed fertility contrasts with the falling trend with fluctuations in period TFR shown in Figure 2-1. The trends look different because of the distinctive attributes of period TFR, which is overly sensitive to changes in the timing of fertility. For instance, the median age at first marriage was 18 among women born in 1926, but it increased to 25 among women born in 1970, and to 29 among women born in 1980 (Appendix 2-A). In the Korean context, in which marriage is universal, these shifts in the timing of marriage are closely connected to shifts in the timing of fertility. This pattern produces a tempo effect that results in an underestimation of period fertility rates (Bongaarts & Feeney, 1998).

Figure 2-3 also displays the educational differentials in completed fertility and how they change over time. In the figure, the education-specific completed fertility shows that, by and large, women's educational attainment is negatively associated with completed fertility: the higher a woman's educational level, the fewer children she has. The fluctuations among women with both some college and more than a bachelor's degree among the oldest cohorts, and among women with an incomplete primary education among the youngest cohorts, are largely due to the small sample sizes.

Overall, the completed cohort fertilities for all of the educational groups declined across the 1926 and 1970 cohorts in Korea. Despite some variation in the slope across the levels of education, it is evident that a sharp fall in fertility took place among women at all educational levels. The group with the lowest level of education—i.e., an incomplete primary education—experienced the largest decline in fertility, from 5.89 for the 1926 cohort to 1.50 for the 1970 cohort.

Meanwhile, the educational differentials in completed fertility almost disappeared among recent birth cohorts with sub-replacement fertility. When we use five-year birth cohorts to mitigate temporal fluctuations between cohorts, we find that the difference between the highest and lowest fertility groups was 2.44 (42% relative difference) among the 1926–1930 cohort, but that this gap shrank to 0.29 (14% relative difference) among the latest 1966–1970 cohort. The lines for education-specific fertility rates have converged below the replacement level at between 1.7 and 2.0. These findings are surprising given that previous studies have argued that educational differentials in fertility remain significant even in post-transitional societies (Bongaarts, 2003). Despite the unprecedented expansion in women's education in Korea, fertility differentials by level of education have faded considerably across the 45 single-year cohorts studied.

The analysis shows that, among the youngest birth cohorts, the two extreme ends of the educational spectrum—i.e., the highest and the lowest educational groups—had the lowest fertility levels. Interestingly, the least-educated women born in 1926, or those with incomplete primary education, had on average the highest number of children; while the least-educated women born in 1970 had the second-lowest number of children. Meanwhile, women with a bachelor's degree or higher had some of the lowest fertility rates across the cohorts. The lower fertility of both groups among the recent birth cohorts is attributable in part to a recent rise in never-married women in those groups. When the 1966–1970 cohorts reached ages 40–44 in 2010 (Statistics Korea, 2015), the proportions of women who had never married was 25.3% among those with an incomplete primary education and 9.3% among those with a bachelor's degree or higher. These shares were higher than the proportion of the entire 1966–1970 cohort who had never married (6.2%), and were far higher than that of the 1926–1930 cohort (0.4% in 1970). A possible explanation for these trends is that when primary school completion is mandatory, women with an incomplete primary education are more likely to be socially disadvantaged or physically/mentally disabled, and would therefore have difficulties finding an appropriate partner. Meanwhile, as the age at first marriage rose steadily, the share of women who remained single through the end of the reproductive span gradually increased, especially among those with the most education.

Was the fertility decline in Korea driven by educational expansion? Table 2-1 shows the change in completed cohort fertility and its decomposition results for five-year birth cohorts. The bottom section of the table provides a comparison between the oldest and youngest birth cohorts. Due to small sample sizes, five-year birth cohorts are used instead of single-year birth cohorts.

While completed fertility declined continuously from the 1926–1930 cohorts to the 1966–1970 cohorts, both the rate effects and the composition effects changed in different directions. Rate effects accounted for about four-fifths of the observed changes in fertility between the cohorts until the 1956–1960 birth cohort. The rate effects over the fertility change declined for the 1961–1965 cohort, and finally began operating in the opposite direction for the most recent cohorts (-31% for the 1966–1970 birth cohort). In contrast, composition effects accounted for about one-fifth of the decline in fertility for most of the birth cohorts, but the contribution of the composition effects to fertility decline soared among the most recent birth cohorts with sub-replacement fertility.

Although the observed change in fertility is small, the compositional change among the 1966–1970 cohort covers more than just the fertility difference from the previous cohort.

Section B at the bottom of Table 2-1 summarizes the results of the decomposition of the change in completed fertility between the 1926–1930 cohort and the 1966–1970 cohort, and their extension for the six educational categories based on composition-standardized completed fertility. The results reveal that four-fifths (79%) of the change in completed fertility (-3.52 per woman) between the 1926–1930 and 1966–1970 cohorts was attributable to changes in fertility behaviors (rate effects), and that the expansion of women’s education accounted for one-fifth (21%) of the change. Dividing the decomposition into educational categories demonstrates how each group contributed to the change in fertility in terms of rate and composition effects. When it comes to rate effects, the contributions of the lower educational groups were especially pronounced. For instance, the changes in the fertility rates of women with incomplete or completed primary education accounted for 23% or 24%, respectively, of the fertility change that occurred between the 1926–1930 and 1966–1970 cohorts. The group of women with upper-secondary education accounted for 16% of the fertility changes between these cohorts. However, the contribution to falling fertility of the rate effects of women with higher education remained marginal: 2% for women with some college and 4% for women with a bachelor’s degree or higher.

The composition effects by level of education were more dynamic. The composition effect of incomplete primary education alone explained 56% of the overall change in fertility; this effect is the largest of all of the rate and composition effects by level of education. Similarly, the compositional change in completed primary education was responsible for 33% of the entire change in fertility. The bulk of the composition effects among the lower educational groups may be attributed to free, compulsory primary education. These large composition effects were, however, offset to a considerable extent by those of more educated groups which operated in the opposite direction (40% for upper-secondary education, 10% for some college, and 15% for a bachelor's degree or higher). Such composition effects indicate that the rapid improvements in women's educational attainment levels achieved in Korea did not necessarily involve a corresponding drop in fertility when rate effects were controlled for. Specifically, the composition effects caused by a decrease in the proportion of the less-educated group were canceled out by the opposite effects caused by a subsequent rise in the shares of groups with the next-highest educational levels (not shown here). Despite the impressive gains made in women's educational attainment, composition effects were found to account for just one-fifth of the entire fertility change during the analyzed interval.

When rate effects and composition effects were considered together, it became clear that the two groups with the lowest educational levels—i.e., incomplete and completed primary education—were mainly responsible for the fertility change. The sum of the rate and composition effects for the two groups was large enough to cover the entire fertility decline. The substantial declines in fertility among the two groups also contributed to the narrowing of the fertility gaps across levels of education among the younger cohorts.

Meanwhile, completed fertility fell below the replacement level among the 1956–1960 cohort. Thereafter, the distribution of both the rate and the composition effects changed, and became different from that of prior birth cohorts. The cohorts of women born after 1960 were the first generation who benefited from the expansion of higher education in the early 1980s. The shift in the pattern of rate and composition effects after the 1961–1965 cohort suggests that Korea had entered the Second Demographic Transition.

The average number of children per woman declined by as much as 3.52 between the 1926–1930 cohort and the 1966–1970 cohort, and the majority of that change was attributable to changes in fertility behaviors. Despite the marked transition in women's educational attainment in South Korea, and contrary to expectations, we found that educational expansion accounted for only one-fifth of the fertility decline between the 1926–1930 cohort and the 1966–1970 cohort, or a drop in completed fertility of 0.74 children per woman. The considerable composition effects of the lower educational groups on falling fertility were offset by the opposite effects due to subsequent growth in the higher educational groups. Therefore, it is difficult to conclude that the expansion of women's educational attainment was the main driver of the fertility decline during the Korean fertility transition.

Can a leader-follower model explain the fertility decline in South Korea? As can be seen in Figure 2-3, fertility rates by level of education are converging. The literature has suggested that this kind of convergence generally occurs when falling fertility spreads successively from leader to follower (Bongaarts, 2003; Cleland, 2002). Figure 2-3 does not provide clear evidence of whether the pattern is close to the leader-follower model. To explore this pattern in more depth, I present cohort parity progression ratios in Figure 2-4. Some of the progression lines were omitted due to the small sample size. In the figure, parity progression rates to parity three (PPR2) and parity four (PPR3) fell considerably for all of the educational levels for the analyzed birth cohorts, while progression rates to parity one (PPR0) and to parity two (PPR1) changed little. These changes suggest that the fertility decline in Korea was mainly attributable to the transition from having four or more children to having two children.

The salient feature of the figure is that education-specific patterns of parity progression represent the stages in the progression of the fertility transition. For example, the shapes of the parity progression ratios for the middle levels of education—i.e., lower- and upper-secondary education—are similar to those of the entire Korean population in the transition from high to low parities: the progression rates to third and fourth births declined considerably, while the progression rates to first and second births remained stable (Choe & Retherford, 2009). Interestingly, the pattern of parity progression ratios for incomplete primary education is also analogous to the beginning stage of the transition, when the shift from high to low parities began. In contrast, the patterns for a bachelor's degree or a higher education seem to indicate the start of a post-transitional stage or of a new set of demographic patterns (the Second Demographic Transition); the progressions to third and fourth births stabilized at low levels, and the progression to a second birth began to decline in recent cohorts. Overall, the figure indicates that the pattern of falling parity progression ratios first began among the most educated group (bachelor's degree or higher) and soon started to take hold among the group with the next-highest level of education. This sequential decline in parity progression, which is consistent with prior research (Cleland, 2002), provides evidence that lower fertility spread from highly educated women (forerunners) to less educated women (followers) during the fertility transition in Korea.

The decline in progression ratios to third-parity births (PPR2) across levels of women's education is more distinctive. Falling progression ratios of third births occurred almost at the same time, but shifted from the more-educated to the less-educated groups. Table 2-2 shows which birth cohorts first experienced significant declines in the progression ratio to third births by women's educational levels. Here, I chose the parity progression ratio of 0.7 for the onset of parity-specific fertility decline, and 0.4 for the loss of parity-specific predominance. Although the choice of thresholds was arbitrary to some degree, it provided a useful way to look at the changes in the fertility pattern. As we can see in Table 2-2, the level of education was associated with the order of the birth cohort who first experienced "significant" declines in the progression: the higher educational group experienced an earlier drop in the parity progression ratio to third births.

Although some of the groups appear to overlap when we attempt to determine which of the birth cohorts first experienced such changes, the table shows that the pattern of falling fertility progressed through educational pathways. The progression ratios to the third birth declined with each level of education. For the two most-educated groups—i.e., some college and a bachelor's degree and higher—the progression to a third birth began to fall below 0.7 in the 1936–1940 birth cohort and reached 0.4 in the 1946–1950 birth cohort. A similar trajectory could be observed among the groups that followed: from upper secondary, to lower secondary, to completed primary, to incomplete primary education. The spread of the decrease in the progression ratio to below 0.4 was even faster than to below 0.7, and the time lag between the educational groups declined from a 15-year to a 10-year cohort interval.

However, none of the groups who experienced a parity progression ratio to second birth (PPR1) fell below 0.7, except for the group with incomplete primary education. Despite substantial changes in fertility patterns, the progression to a first and a second birth have been consistently maintained by the majority of women, which implies that a two-child family norm has been well established in Korea. For those with incomplete primary education, the parity progression ratio to parity two reached 0.7 among the 1961–1965 cohort, but its impact on the overall trend can be ignored because the corresponding cohorts came from generations in which free, compulsory primary education had been instituted (less than 1% of the cohorts).

The results of the cohort parity progression analysis offer evidence that the pattern of the Korean fertility transition most closely conforms to the leader-follower model. Although fertility fell in all of the educational groups with a small variation in birth cohorts, the decline definitely spread from the most- to the least-educated groups. In addition, despite the sustained low fertility in Korea, the two-child family norm seems to be firmly established in all of the educational groups, and the tendency to have a third child has declined considerably during the transition. This striking transformation in parity progression patterns was completed in just 40 years of birth cohorts.

Discussion and Conclusion

South Korea experienced one of the most rapid declines in fertility of any country in the late 20th century. The aim of this paper was to identify how educational differentials in fertility changed over the Korean fertility transition, and to understand the contribution of changes in educational attainment to the fertility decline among women born between 1926 and 1970.

Completed fertility declined from 5.51 for women born in 1926 to 1.73 for women born in 1970. Educational differentials in completed fertility have gradually decreased. Although marginal differences still remain, the once-obvious gaps in lifetime fertility by level of education disappeared among the birth cohorts of women who just ended their reproductive periods. In the recent cohorts, women at both extremes of the educational spectrum had the lowest levels of completed fertility. This finding blurs the negative association between fertility and women's education that was clearly observed in the early stages of the transition. Overall, educational differentials in completed fertility faded away as the transition reached its end. This convergence of educational differentials in fertility is surprising because it contradicts previous research showing that the fertility gaps between educational groups are substantial in most societies, even those in the end- or post-transitional stage (Abbasi-Shavazi et al., 2008; Alves & Cavenaghi, 2009; Bongaarts, 2003, 2010).

The extraordinary decline in fertility in Korea was mainly attributable to decreasing fertility in every social group for the cohorts who were having children prior to the point when the replacement level was reached. Women's educational attainment did not start to play a large role in fertility changes until after this point. While the rapid increase in women's educational attainment was virtually unprecedented, it still only accounted for one-fifth of the fertility decline during the transition in Korea. The pattern of fertility differentials by level of education in Korea appears to have conformed with the leader-follower model rather than with the permanent-difference model (Bongaarts, 2003; Cleland, 2002). Having experienced more rapid fertility decline, the Korean pattern could be identified through cohort parity progression ratios by level of education. The trends in parity progression ratios demonstrate that the decline in fertility spread from the most-educated to the least-educated groups during the fertility transition, and that the norm of a two-child family became established across all social strata in Korea. Such a rapid transformation of fertility patterns cannot occur without the extensive diffusion and social interactions of small family norms and contraceptive use, as prior research has discussed (Chung & Das Gupta, 2007; Kye, 2012; Montgomery & Chung, 1999).

Differences in rates of diffusion and social interactions may lead to further variation in the dynamic pattern of educational differentials in fertility across countries (Bongaarts, 2003). For instance, family planning programs can reduce the fertility gap across social strata by helping to meet the contraceptive needs of disadvantaged women (Amaral & Potter, 2009). In Korea, the family planning program was initially targeted at women in rural areas with high fertility rates and limited access to birth control (Kwon, 2001). As the result of active fieldwork and campaigns, contraceptive use and the small family norm spread from one group to another (Montgomery & Chung, 1999; Park et al., 1976). In countries in the late-transitional stages, in which most of the differences in fertility rates come from differences in rates of unwanted pregnancies (Bongaarts, 2003, 2010), family planning programs may be more useful than is generally expected in narrowing the fertility gap across social strata. Without such efforts, fertility differentials by social strata may remain significant even after countries lower their overall fertility to replacement levels, as in the case in Brazil (Alves & Cavenaghi, 2009; Lam & Duryea, 1999).

For the same reason, the degree of homogeneity in a society could influence the extent of fertility differentials. Innovative ideas and behaviors may spread more quickly in a homogenous society than in a heterogeneous society once the adoption of the innovation reaches a certain threshold. Located on a small peninsula in which the land route north has long been closed by the political conflict with North Korea, South Korea is an ethnically homogenous society with a single language. Having a relatively homogenous culture and geographic constraints likely facilitates social interaction and the diffusion of innovative ideas and behaviors in Korea. Thus, the Korean pattern of educational differentials in fertility may differ from the patterns found in other countries.

Internal migration might have contributed to the converging patterns of fertility differentials. Industrialization and urbanization triggered large-scale internal migrations from rural to urban areas between the 1960s and 1980s in Korea. Internal migrants from rural areas contributed to the decline in fertility through their acceptance of contraceptive use and the small family norm (Lee & Farber, 1984; Lee & Pol, 1993). However, because most of the people affected by this trend were from birth cohorts involved in the early phases of the transition, internal migration probably did not play an important role in the overall pattern of fertility differentials.

When interpreting the results of this study, several points should be noted. First, these findings should be differentiated from research based on period fertility. Cohort fertility measured at the end of the reproductive span is usually less responsive than period fertility in reflecting the dynamic changes in fertility at younger ages. Although completed cohort fertility may mask qualitative aspects of fertility behaviors, such as birth timing and birth spacing, it is relatively stable and precise. By contrast, period measures of fertility may present a distorted picture, especially when the timing of childbearing changes as rapidly as it did in Korea (Bongaarts & Feeney, 1998).

Second, the findings do not indicate that improvements in women's educational attainment are not a necessary prerequisite for fertility decline. My analysis showed that a considerable portion of the fertility decline was attributable to compositional changes in the lower educational groups, caused by the introduction of universal primary education. In addition, education helped to spread new ideas and values. This paper supports the hypothesis that mass education provides a solid foundation for fertility decline in both direct and indirect ways, and that the indirect effects of education on fertility are greater than the direct effects (Axinn & Barber, 2001; Caldwell, 1980).

This study also has a few limitations. First, I could not use detailed information on fertility other than number of children ever born. Educational differentials in completed fertility can be further decomposed into differences in wanted and unwanted fertility, and their contributions to fertility differentials also vary with the stages of the transition (Bongaarts, 2003; Musick et al., 2009). Once better data become available, decomposing the fertility difference and how it changes over time would be an interesting topic. Second, the completed fertility rates used here may have been marginally underestimated due to data limitations, although this did not appear to make a meaningful difference in the results. With the data for Korea that are currently available, it is difficult to estimate the exact levels of fertility for women with non-traditional childbearing histories, such as those who had out-of-wedlock births or are childless. Finally, as the information on children ever born comes from retrospective questions, the number may be underestimated due to incorrect recall or the omission of children who died.

Despite these shortcomings, this paper provides a rare look at how educational differentials in fertility change in a country that has experienced a rapid decline in fertility as part of a fertility transition. In Korea, the sustained low fertility has brought on social concerns in recent years. However, looking at cohort fertility rather than period fertility, raises the question of whether or not the Korean fertility has reached the lowest-low level. Researchers and policy makers should pay more attention to the timing of fertility which determines period fertility, especially in countries where age at childbearing changes rapidly as in Korea (Bongaarts & Feeney, 1998). The effects of education on fertility decline are diverse and vary according to the conditions of each country. The Korean pattern of educational differentials in fertility illustrates the need for a more comprehensive understanding of the relationship between education and fertility transition.

Table 2-1

Standardization and Decomposition of the Change in Completed Cohort Fertility.

A. Standardization and decomposition of change in completed fertility

Birth cohort	CF	CF standardized except		Change in CF		Change attributable to			
		Fertility rates	Educational composition			Rate effects		Composition effects	
C1926–1930	5.36	4.83	3.49						
C1931–1935	4.78	4.34	3.41	-0.58	(100%)	-0.49	(85%)	-0.09	(15%)
C1936–1940	4.07	3.79	3.25	-0.71	(100%)	-0.55	(78%)	-0.16	(22%)
C1941–1945	3.41	3.26	3.11	-0.66	(100%)	-0.52	(79%)	-0.14	(21%)
C1946–1950	2.79	2.79	2.97	-0.62	(100%)	-0.48	(77%)	-0.14	(23%)
C1951–1955	2.29	2.35	2.91	-0.50	(100%)	-0.44	(88%)	-0.06	(12%)
C1956–1960	1.96	2.08	2.85	-0.33	(100%)	-0.27	(81%)	-0.06	(19%)
C1961–1965	1.88	2.04	2.80	-0.09	(100%)	-0.04	(42%)	-0.05	(58%)
C1966–1970	1.84	2.05	2.75	-0.04	(100%)	0.01	(-31%)	-0.05	(131%)

B. Decomposition of change in CF between the oldest (c1926–1930) and youngest (c1966–1970) cohorts

Birth cohort (by level of education)	Observed change in CF	Change in CF*		Change attributable to			
				Rate effects		Composition effects	
C1926–1930 / c1966–1970	-3.52	-3.52	(100%)	-2.78	(79%)	-0.74	(21%)
Incomplete primary		-2.80	(80%)	-0.82	(23%)	-1.98	(56%)
Completed primary		-2.03	(57%)	-0.86	(24%)	-1.17	(33%)
Lower secondary		-0.18	(5%)	-0.33	(9%)	0.15	(-4%)
Upper secondary		0.84	(-24%)	-0.55	(16%)	1.39	(-40%)
Some college		0.27	(-8%)	-0.08	(2%)	0.34	(-10%)
Bachelor’s degree or higher or more		0.38	(-11%)	-0.15	(4%)	0.53	(-15%)

Note: * For the six educational categories, standardized CFs for component were used.

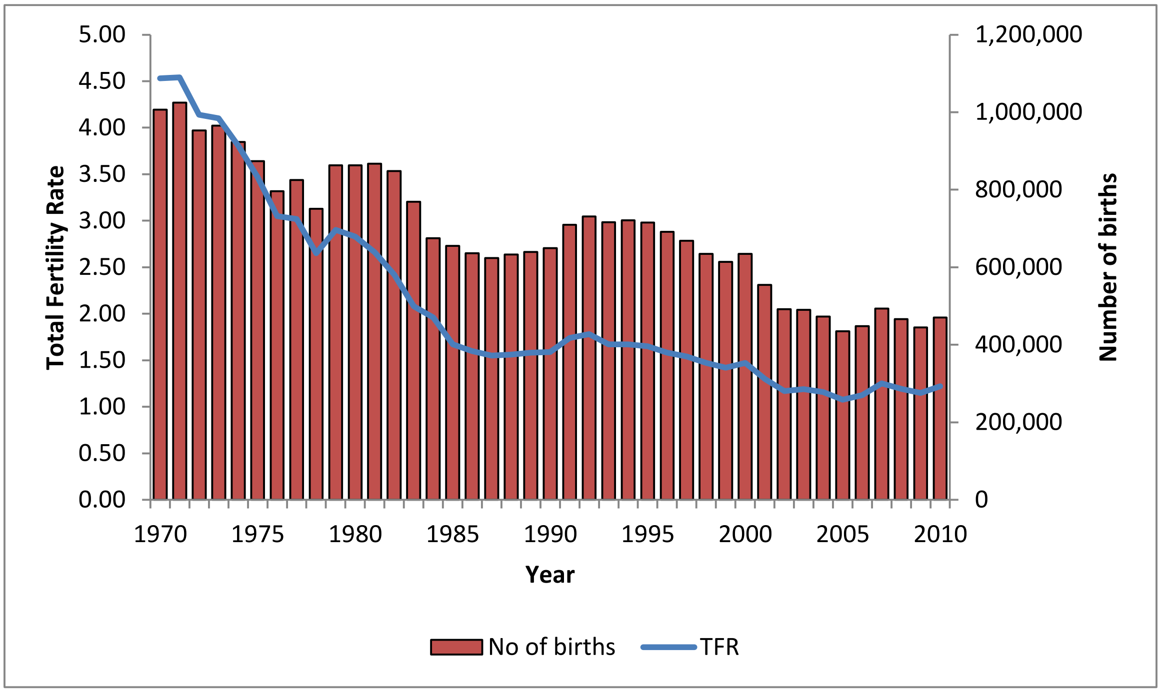
Table 2-2

The First Birth Cohort Reached below 0.7 or 0.4 of Parity Progression Ratios by Level of Women's Educational Attainment.

Level of education	Parity progression ratio to third births (PPR2)	
	below 0.7	below 0.4
Incomplete primary	c1951–1955	c1956–1960
Completed primary	c1951–1955	c1956–1960
Lower secondary	c1946–1950	c1951–1955
Upper secondary	c1941–1945	c1951–1955
Some college	c1936–1940	c1946–1950
Bachelor's degree or higher	c1936–1940	c1946–1950

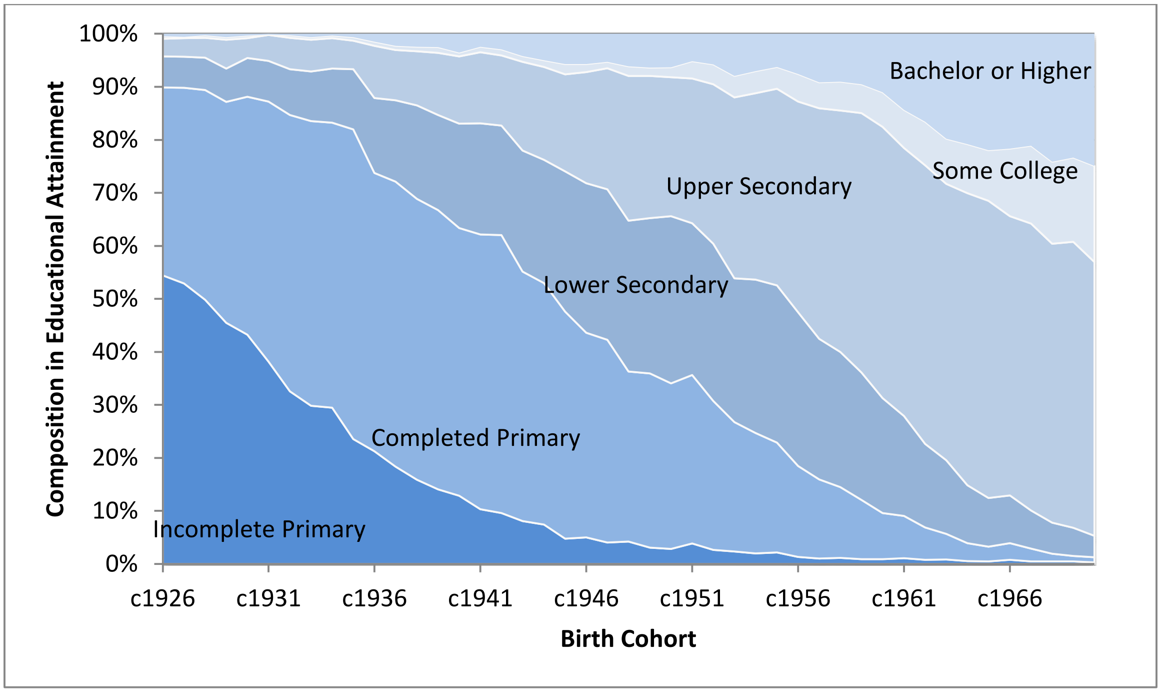
Note: Author's calculations from Korean census sample data between 1970 and 2010.

Figure 2-1. Total Fertility Rates and the Number of Births in South Korea, 1970–2010.



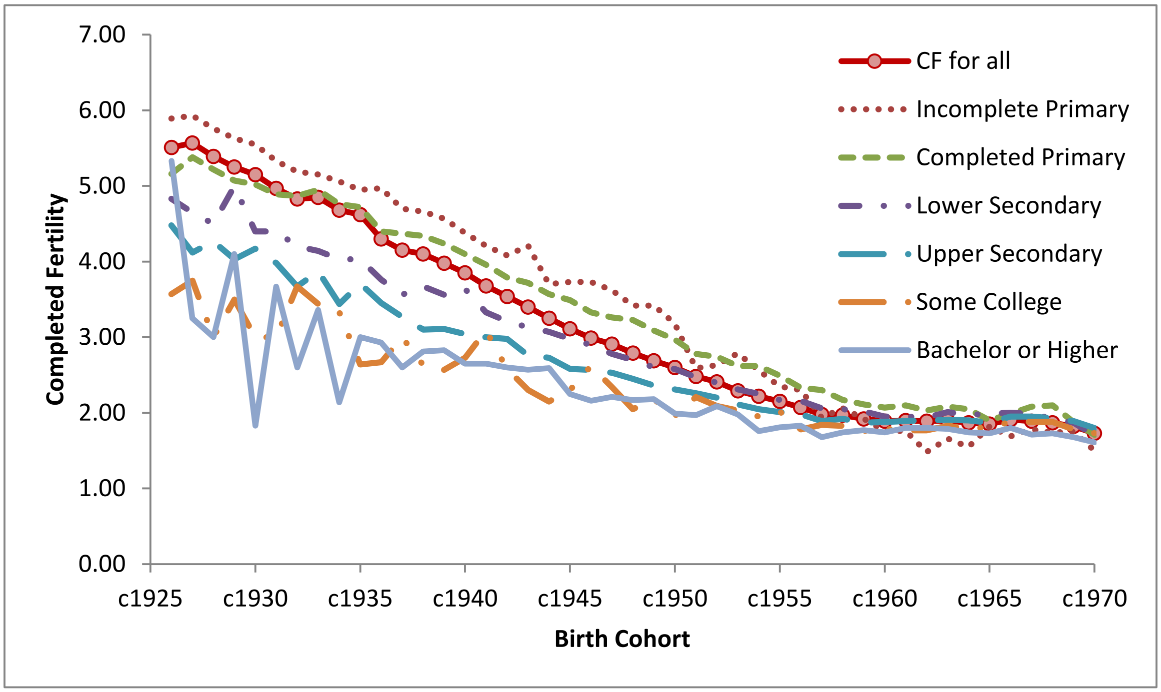
Source: Statistics Korea (2015).

Figure 2-2. Compositional Change in the Educational Attainment of Women Aged 40–44 for the 1926–1970 Birth Cohorts, South Korea.



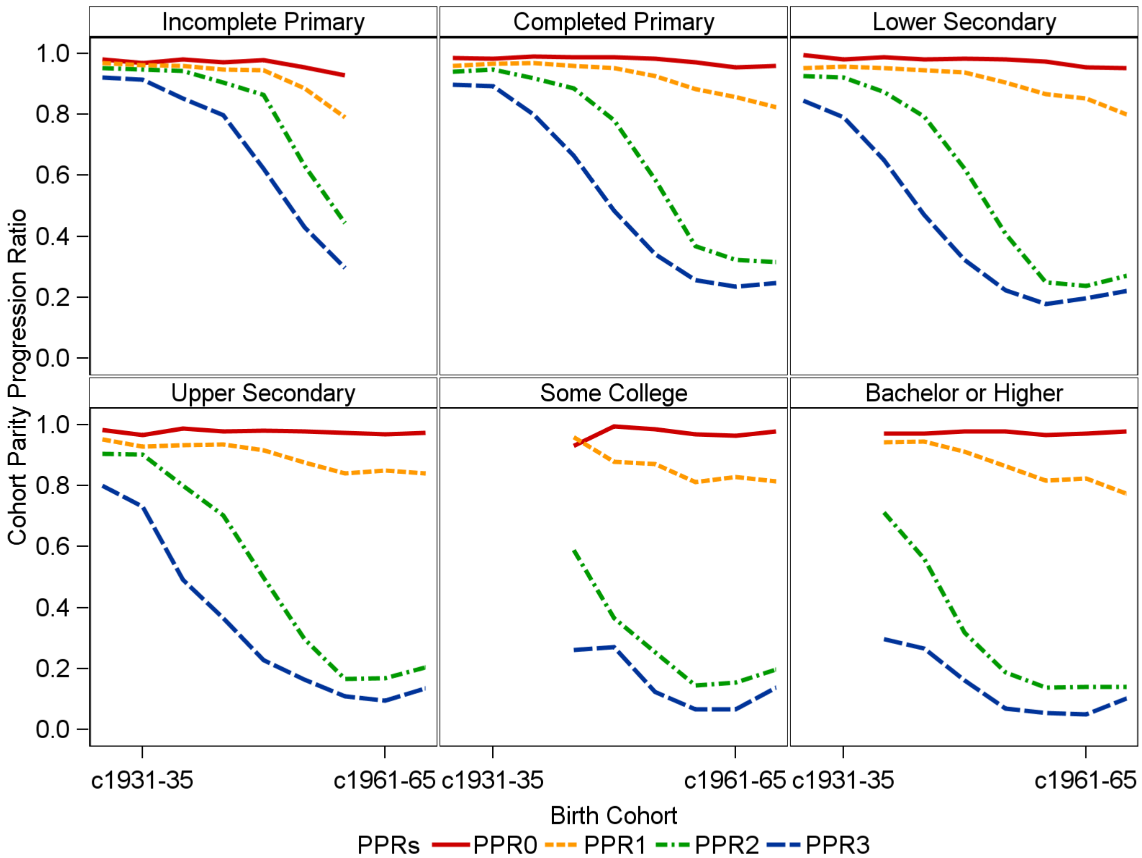
Note: Author's own calculations from Korean census sample data between 1970 and 2010.

Figure 2-3. Educational Differentials in Completed Cohort Fertility for Women Born between 1926 and 1970, South Korea.



Note: Author's calculations from Korean census sample data between 1970 and 2010.

Figure 2-4. Cohort Parity-Progression Ratios by the Level of Women's Educational Attainment between the 1926–1930 Cohort and the 1966–1970 Cohort, South Korea.



Note: In cases in which an educational group represents less than 1% of the samples for the corresponding cohort, the parity progression ratios for the group were omitted in the figure above. Author's calculations from Korean census sample data between 1970 and 2010.

CHAPTER 3

MARRIAGE POSTPONEMENT AND RECUPERATION

Introduction

Over the past decades, delaying marriage has become increasingly common in most developed countries. In European countries and the U.S., young people are increasingly postponing marriage and many are electing other forms of families such as cohabitation and single-parent families (Billari & Liefbroer, 2010; Lesthaeghe & Moors, 2000; Sobotka & Toulemon, 2008). Marriage has become less desirable for younger generations and it is no longer necessary for childbearing. Despite considerable variation between and within countries, overall, the centrality of family moved away from marriage, and childbearing has been decoupled from marriage in European countries and the U.S.

Marriage delay is closely related to sustained low fertility in East Asia, but little is known about how it developed and proceeded. Women's mean age at first marriage has continuously increased in East Asian countries since the early twentieth century (Jones, 2007; Jones & Bubhaju, 2009). The rise in women's age at first marriage, which contributed to fertility decline in the second half of last century, is attributable in part to extended education, an increase in social and economic activities, and growing economic uncertainty. However, the biggest difference from Western countries is the strong bond between marriage and childbearing in East Asia. Most childbearing still occurs within marital unions and non-marital births remain marginal in this region. Cohabitation has grown at a very slow pace and is not yet common. The growing number of women with tertiary education accounts for marriage delay to some extent, but it is not the primary factor in Japan and South Korea (Jones & Gubhaju, 2009).

Marriage is still an important proximate determinant for fertility and an essential aspect in understanding family dynamics, especially in East Asia. Research on marriage delay is usually concerned with changes in the prevalence and timing of first marriages, such as the proportion of ever-married women and the mean (or median) age at first marriage. Differences in prevalence and timing are often used for understanding educational differences in marriage as well. However, marriage occurs at all ages and its progression with regard to age may differ by level of education. The simple cross-cut of marriage rates or the mean age at marriage across levels of education might reflect fragmentary aspects only. Since marriage *delay* implies a comparative perspective—generally compared to existing norms or expectations—the comparison of marriage schedules across birth cohorts can be a useful strategy for studying this topic.

This study investigates how much marriage is delayed and to what extent the delay is made up later, namely, the marriage *postponement* and *recuperation* (P&R) process from the cohort comparative perspective. Looking at age trends in cohort first-marriage rates, I describe the marriage P&R process over birth cohorts and how that process has developed. I also examine whether the process differs across different levels of education. As a case study, I focus on South Korea, which has experienced rapid demographic changes and marked educational expansion. Based on recent trends in the marriage P&R process, I also provide cohort projection scenarios of marriage rates at the end of the reproductive span for upcoming cohorts that have passed primary marriage ages. This study contributes to the literature by suggesting distinct insights into the dynamic changes in marriage timing.

Change in Marriage Timing

Marriage delay has become common in most industrialized countries over the past decades. In European countries and the U.S., women's period-mean ages at first marriage were in the early 20s before the 1960s, but since then, mean ages have increased to the late 20s starting with Sweden and moving to Eastern European countries (Sobotka & Toulemon, 2008: 96, Figure 3). East Asian countries have also experienced a rapid rise in the age at first marriage. According to Jones and Gubhaju (2009), between 1970 and 2005, women's singulate mean age at marriage (SMAM) rose from 22–25 year of age to the late 20s and near 30 in most countries in the region except for China where most women still marry in their 20s. Marriage delay along with sustained low fertility makes demographic changes in both regions look similar.

The trends in marriage delay, however, are quite different. During the first fertility transition, marriage timing changed little in most European countries. It is well known that the mean age at first marriage of the "European marriage pattern" was higher than in any other region of the world (Hajnal, 1965). SMAMs for women were mostly in the late 20s, and roughly 10–20% of women remained single at ages 45–49 in most Western European countries. The age of women's marriages changed universally to younger ages soon after World War II, which contributed to a baby boom in the U.S. In Europe and the U.S, substantive marriage delay did not appear until the 1960s. Since then, marriage has continued to be delayed and frequently replaced with cohabitation in most countries, although this trend varies across and within countries.

In contrast, in East Asian countries, an increase in the age at first marriage has continued. Although data is not available for all countries, women's SMAM was 21.2 in 1920 for Japan, 21.1 in 1920 for Taiwan, and 15.9 in 1925 for Korea, and marriage age did not surpass age 23 until the 1960s in most countries in this region (Atoh, Kandiah, & Ivanov, 2004; Kwon, 2007), a clear distinction from the European marriage pattern. The rise in marriage age also contributed to fertility decline to some extent although the decline in this region was mainly attributed to a decline in marital fertility. The greatest difference is the universal marriage pattern in East Asia. The proportion of never-married women at age 45–49 was less than 2% in 1960, but still remained under 10% in 2005 in Japan, Taiwan, and South Korea (Atoh, Kandiah, & Ivanov, 2004; Jones & Gubhaju, 2009). East Asian countries entered post-transitional stages (or the second demographic transition) between the mid-1970s and early 1980s, but marriage delay has continued. Unlike European countries, cohabitation is not yet common and non-marital births are still rare (5% or below through the 2000s in Japan, Taiwan, and South Korea). Thus, sustained marriage delay directly contributes to the lowest-low fertility in East Asian countries.

Characteristic features of marriage delay in East Asia are relatively less known. With different histories and backgrounds, East Asian countries may have more dynamic patterns of marriage transition than Western countries. For instance, the mean age at first marriage in most East Asian countries rose close to its European counterparts or higher in recent years but non-marriage did not correspondingly increase. This suggests that considerable marriage-delay situations were made up in later ages, though the link between marriage delay and lifetime singlehood has gradually intensified. Such “recuperation” might have been even stronger in the past given that the rise in age at first marriage has continued since the early twentieth century while celibacy rates (remaining single at ages 45–49) remained stable until recent years. Unlike Western countries, given the sustained trends, contemporary marriage delay in East Asia can be better understood from a long-term perspective. The factors that differentiate the recent marriage delay from earlier patterns can illuminate how marriage timing has changed in East Asia and sheds light on commonalities and differences of the second demographic transition between East Asian and Western countries.

Marriage delay should be differentiated from non-marriage because not all marriage delays are linked to non-marriage. Oppenheimer (1988; 1997) claimed that educated women more often delay marriage but do not necessarily end up more non-marriage as they also desire marriage and eventually marry later. This essentially describes the process in which delayed marriage is made up in late ages. The recuperation of marriage delay among educated women is confirmed by Goldstein and Kenney (2001), who reported a “crossover” of marriage rates between college graduates and non-graduates among the 1954–1959 and 1960–1964 cohort: the cumulative proportion of ever-married women for college graduates was lower than for non-graduates in their 20s, but gradually increased and was projected to be higher than non-graduates. These studies noted the distinction between marriage delay and marriage forgone but missed the process of marriage recuperation.

The recuperation of delayed marriage has not been properly conceptualized in the literature. Research frequently analyzes mean age at first marriage or the risk of marriage and compares it with the proportion of ever-married at the reproductive end. However, such static measures have limits in exploring significant changes in marriage delay and the catching-up process. A few studies also build on a deterministic assumption of the marriage schedule using forecasting methods (e.g., Coale & McNeil, 1972). For instance, Goldstein and Kenney (2001) assumed the diffusion of marriage within women of a cohort to estimate cohort marriage schedules. This deterministic assumption on marriage timing might be useful for forecasting purposes, but it is unrealistic and might deviate from actual observations particularly in societies where marriage schedules rapidly change or depart from the standard distribution of marriage age. As a result, a lack of understanding exists on the frequency of marriage delays and actual recuperation.

The marriage postponement and recuperation process differs by level of education. Generally, educated women delay marriage, but whether they end up with lower celibacy rates varies with context. The association between higher education and lifetime singlehood is positive or insignificant in less traditional societies such as Sweden and the U.S., but it is negative in gender-inegalitarian societies like Japan (Blossfeld, 1995; Ono, 2003). In particular, educated women marry *less and late* even after controlling for school enrollment (Raymo, 2003). This suggests that the mechanism of family formation is different in places like East Asia where gender inequity remains substantive despite recent improvements. Thus, understanding the dynamic change in marriage timing should take into account regional contexts.

In East Asian countries including Korea, educated women delay marriage more than other women. With economic independence, educated women are more likely to recognize and avoid the burdens of traditional gender roles and duties imposed on women (as wives, mothers, and daughters-in-law) regarding marriage and childbearing. Marriage postponement and avoidance can be a useful strategy to avert such risks in societies with gender inequity (McDonald 2002). The tradition of hypergamy, women's practice of marrying "up" to men with higher status, also makes it difficult for the most educated women to marry in East Asia. However, educated women are also more likely to get married eventually (marriage recuperation). Having more resources, educated women have advantages in overcoming the demanding process of finding a suitable partner in the marriage market, which requires substantive time and effort (Oppenheimer, 1988; 1997). This is in part evidenced by a recent increase in international marriages, that is, marriages between the most educated women in this region to men from more developed countries (e.g., Kim, 2010). Taken together, the educated groups of women are more likely to delay and recuperate marriage than others, resulting in marginal differences in celibacy rates at the reproductive end in East Asia.

The marriage P&R process is complex and it is not yet well understood how much marriage is delayed, how much of the delay is made up in later life, and whether marriage delay eventually produces lifetime singlehood. Given trends in marriage delay in East Asia, the marriage P&R process will continue for an unknown period of time. This study measures the marriage P&R process from the cohort perspective and shows how this process has developed in South Korea as a case study in East Asia. This study also examines whether that process differs by level of education and how it might change in the near future.

Marriage in the Context of Korea

As other studies have summarized descriptive changes in marriage age and non-marriage in Korea (see Kwon, 2007), I briefly overview the change in marriage timing. In

Korea, early marriage was the social norm in the Chosun Kingdom (1392–1910), which adopted Confucianism as a ruling ideology. In the Chosun pre-modern society, marriage was considered a union between two lineages that contributed to expanding and maintaining a family's socioeconomic influence rather than a union between two individuals (Chang, 1979). Thus, parents arranged almost all marriages in the pre-modern period. Given the high mortality in a pre-modern society, early marriage might also be advantageous in achieving marriage's first objective: the continuation of family lineage through sons.

Since the first census in 1925, the mean age at first marriage has increased monotonically for both men and women (see Figure 3-1). SMAM was 20.2 for men and 15.9 for women in 1925 and the proportion of never-married women by ages 20–24 was less than 2% until 1930 (Kwon, 2007). Korea's early and universal marriage pattern was one of the earliest and greatest marriage patterns in the world at that time (Hajnal 1965: 102).

The substantial marriage delay first appeared between 1940 and 1955, when Korea experienced turbulent history during World War II, liberation in 1945, and the Korean War (1950–1953). The SMAM increased from 21.0 to 24.6 for men and 17.5 to 20.5 for women during this period. The shift of age at first marriage was mainly due to massive migration and selective mortality caused by a series of political events. Wars and subsequent unrest triggered marriage delay for both men and women as well as unbalanced sex ratios at marriageable ages caused by wars (Lapierre-Adamcyk & Burch, 1974).

Marriage rates began to decline while the mean age at first marriage continued to increase between the 1960s and the 1990s. Marriage delay has gradually continued through modernization and urbanization first and then through extended education and women's participation in social and economic activities. The transition from arranged marriages to love marriages is also noteworthy. According to a national survey in 1991 (Gong et al., 1992), arranged marriages that were completely determined by parents—which comprised 48% of the marriage cohort before 1964—almost disappeared for the marriage cohort after 1990 (1.2%).

The Asian financial crisis in 1997–1998 also changed marriage patterns to a great extent. Economic constraints further delayed marriage and late marriage gradually became prevalent throughout the country. Young people became more aware of economic uncertainty when making important decisions in regards to careers, marriage, and childbearing. The SMAM finally surpassed age 30 for both men and women, with 33.16 for men and 30.25 for women in 2010. In a period perspective, the period total first marriage rates—the sum of age-specific first marriage rates in a certain time or period—have declined greatly since the late 1990s (Kwon, 2007:231-235). However, the proportion of never-married women at ages 45–49 was still 2.4% in 2005, suggesting that universal marriage has maintained in Korea.

< *Figure 3-1 is about here* >

The discrepancy between high SMAM and low non-marriage implies a strong recuperation of delayed marriage. Recent studies (Park, Lee, & Jo, 2013; Woo, 2009) confirmed the trend toward *late and less* marriage among recent cohorts. The studies indicated that educated women more often delay marriage but the gap in non-marriage is minimal as the educated eventually marry at older ages. Park and colleagues (2013) found that the lowest educated (less than secondary education) began to show a non-traditional marriage pattern—the greatest marriage delay and non-marriage, but due to the group's marginal share, not much importance has been attributed.

Both studies relied on a decade-birth cohort, probably due to the lack of sample size and they mainly focused on relatively recent trends, that is, changes in marriage timing after the late 1990s Asian financial crisis. Furthermore, apart from measurement issues, these studies used either the deterministic assumption of the *Hernes* model (Woo, 2009) or the discrete time hazard model (Park et al., 2013). As a result, historic patterns of marriage delay and the *recuperation* process were omitted and overlooked in the literature.

To address the research gap, this study investigated the degree to which a cohort of women postpones marriage and catches up in later ages. This study described the marriage P&R process, which has lasted in Korea from pre-transitional stages to the present, and demonstrates how that process differs by level of education.

Measuring Marriage Postponement and Recuperation

The concept of marriage delay is arbitrary and subjective. The ambiguity of marriage delay might impede a clear understanding of the dynamics of the marriage P&R process. Due to the subjective meaning of delay, no one can say whether an individual delays marriage until the person's original plan and eventual outcome are known. That is, individual plans about marriage frequently change with conditions and life trajectories. However, such data is not widely available. At the aggregate level, however, the marriage schedule of a group can be compared with others. The marriage P&R process is inherently a cohort phenomenon because staying single to the end of the reproductive cycle is an outcome of successive decisions and behaviors that cumulate over a life course (Ryder, 1951). Therefore, differences in marriage schedules over ages can be used to identify the marriage P&R process. Specifically, this study utilized the gap in the cumulative marriage rate in younger ages that continues through older ages as an evidence of marriage delay or marriage foregone at the aggregate level. Building on prior research (e.g., Frejka, 2011; Sobotka et al., 2012), I investigated the marriage P&R process by quantifying the extent of marriage delay and how much delayed marriage at early ages is then recuperated at later ages.

As total fertility rates have declined in most developed countries in the past decades, demographers have begun to debate whether an actual decline in fertility exists or if it is just a matter of transitioning to childbearing in later ages. The latter is also called the "postponement transition (Kohler, Billari and Ortega, 2002)." Several of these debates have developed and elaborated a way to measure the postponement and recuperation of childbearing in a cohort fertility perspective (Frejka, 2012; Frejka & Calot, 2001; Frejka & Sardon, 2004; Lesthaeghe, 2001; Sobotka et al., 2012). Compared with previous cohorts, fertility decline in younger ages is considered as childbearing *postponement* while fertility gain in later ages is regarded as recuperation of delayed childbearing.[4] Authors have measured the gap in cumulative cohort fertility rates over ages between two birth cohorts of interest (see the details for childbearing context,

[4] I use marriage *postponement* and *recuperation* and marriage *delay* and *catching-up* interchangeably.

Sobotka et al., 2012). I applied this method to the marriage P&R process. To be specific, marriage *postponement* indicates an absolute (or relative) decline in cohort first marriage rate (CFMR), which is equivalent to the proportion of ever-married when the cohort of interest is contrasted with the benchmark. The *postponement* is measured at the age where the gap is maximized. Marriage *recuperation* is also measured by absolute (or relative) gains in the cumulative cohort marriage rate from the greatest gap.

The way to measure the *postponement* and *recuperation* is also illustrated in Figure 3-2. Comparing two hypothetical cohort *a* and *b*, consider the older cohort *a* as a benchmark cohort. The cohort *a*'s CFMRs for ages 13–44 were considered as a baseline, which is a horizontal line at zero.[5] For the cohort *b*, the age-specific difference in CFMRs from the benchmark is depicted as a trend line. The falling curve in the left side represents a decline in CFMR of the cohort *b* at younger ages compared to the benchmark (cohort *a*), while the rising curve on the right side indicates an increase in CFMR at older ages offsetting the marriage deficit in younger ages. Again, the decline in CFMR at younger ages is considered as *marriage postponement* (*P*), which is measured at the *trough* age with the greatest gap, and the subsequent rise in marriage rate at older ages is labeled as *marriage recuperation* (*R*). The ratio of marriage recuperation over postponement is computed as *Recuperation Index* ($RI = P*100 / R$). Three measures (*P*, *R*, and *RI*) are used for comparisons over cohorts across levels of education.

[5] Since a few women reported that they married before age 15, I use 13 as the lower limit of the age range.

These measures can also be measured through a relational model that compares the cohort of interest with a moving benchmark, such as an immediate previous cohort (Lesthaeghe, 2001). The essential part of the relational model is identical with the base model except for setting a moving benchmark. Thus, I did not discuss it further here. In this study, I used this relational model only when the result of base model is not clear.

<Figure 3-2 is about here>

As the marriage P&R process is ongoing in Korea, key indicators in the base model could be utilized to formulate cohort projection scenarios. To project CFMR at age 45, that is, the proportion ever-married by age 45, any cohort that reached the trough age could be used as shown in the equation below:

$$pCMR_i = CMR_{benchmark} + P_i(1 - pRI_i),$$

where *i* and *p* stand for the cohort of interest and the projected value, respectively.

The formula illustrates that the projected CFMR at age 45 is equal to the CFMR of the benchmark plus the absolute postponement (*P*) at the trough multiplied by the final decline in CFMR, which is 1 minus the projected *RI*. The only variable to be projected is the *pRI*. As a prior study (Sobotka et al., 2011) pointed out, there are many ways to project recuperation. Considering data limitation, however, this paper adopted two approaches: keeping the most recently observed RI constant and using a linear trend from the recent two RIs.

These methods provided a useful opportunity to quantify the marriage P&R process. A visualization of the marriage P&R process offers an intuitive understanding about the current state and how it has developed with regard to marriage. Three measures (*P*, *R*, and *RI*) also enabled us to compare differences in the dynamics of marriage transition across cohorts and levels of education. Furthermore, these measures could also be used for variant cohort-projection scenarios of the proportion of ever-married.

Data and Methods

Data. This study used data from the 1975, 1990, 2005, and 2010 Korean census and 1% samples data in which age at first marriage is available. The Population and Housing Census of Korea is conducted by Statistics Korea every five years. The censuses include a short sample survey on demographics such as age, sex, education, and marital status as well as the occasional age at first marriage. Having larger sample sizes, these data were advantageous over others for estimating cohort-specific marriage schedules. From each available census, data on women aged 30–59 and their educational attainment were collected for this study. Considering the possibility of misreporting marriage age and possible selection by mortality differentials, I excluded the responses from women aged 60 or higher. Also, I included responses from women aged 30 and older only because most women complete their highest education before that age in Korea. For this study I also considered women who stayed single by age 45 as lifetime singlehood (celibacy). I acknowledged that women getting married in their 40s and 50s has increased in recent years. However, since a late marriage around the end of reproductive years is still rare, especially for a first marriage, I did not consider it for this study. Furthermore, using age 45 as an upper limit made it possible to include more recent cohorts into the analysis. As a result, the final analytic sample included 338,307 cases and a sample size for every 5-year birth cohort varies from a minimum of 4,886 to a maximum of 58,286 cases. The subsample for the second part has 192,041 cases and a larger sample size for each cohort that ranges from 16,948 to 58,286 cases.

Analytic strategy. I employed the cohort analysis that was originally developed for the analysis of childbearing postponement. As described in the section above, this method was useful in demonstrating the shift of childbearing from younger ages to older ages. Taking advantage of the method, I applied it to the study of marriage timing. The analysis of this study is divided into three subsections: (1) historic change in the marriage P&R process, (2) recent variations by level of education, and (3) cohort projections based on trends in the marriage P&R process. In the first section, I provided a description about how the marriage P&R process has developed over the cohorts of women born between 1916 and 1980. The graphical illustration demonstrates how marriage postponement has occurred and to what extent delayed marriage has ended with non-marriage. Key measures of the marriage P&R process are also summarized in a separate figure.

The second section reviews a variation of the marriage P&R process across levels of education. Due to a substantive educational transition in Korea, I could not use the same educational categories for the entire cohorts analyzed in this study. I separate the cohorts into two groups, according to the cohort that entered the replacement level of fertility: the cohorts born before 1960 and the cohorts born in and after 1960. In the preliminary analysis, the older cohorts born before 1960 did not show much variation across levels of education (see Appendix A). Therefore, I focused on the younger cohorts born between 1956 and 1980, which most benefited from the expansion of higher education. Due to a small sample size for less educated groups, I used a five-year birth cohort, instead of a single-year birth cohort. I included the 1956–1960 cohort as a benchmark that represents the ending cohort of the first demographic transition to compare changes in the marriage schedule against toward the "modern" pattern.

Lastly, I provided cohort-projection scenarios of the ever-married proportion (CFMR). Key measures (*P*, *R*, and *RI*) of the marriage P&R process were utilized to make projections for the latest cohorts that passed the trough age. As the maximum postponement (*P*) was known for the cohorts that passed the trough, the CFMR at age 45 could be easily computed once the recuperation index (*RI*) is estimated. I used two different approaches to estimate the *RI* for the purpose of comparison: *stable RI* and *trend RI.* I made education-specific projections with both *stable RI* and *trend RI* and then eventually integrated the education-specific trends and educational composition together into the projection scenarios for the entire cohorts. This was the simplest way to demonstrate the advantages of the projections that take into account the dynamics of the marriage P&R process.

Results

Trends in marriage postponement and recuperation. The trends of women's marriage rate from the 1916–1920 cohort to the 1976–1980 cohort are illustrated in Figure 3-3. The upper graph (a) represents the survival curves of never-married women by age. From the far-left blue line for the 1916–1920 cohort to the far-right line for the 1976–1980 cohort, the marriage schedule has continuously delayed in Korea. The cohort-specific lines tend to converge around the bottom as they reach to age 45, suggesting that most women eventually marry in Korea. However, the younger cohorts born in and after the 1970s began to depart from these lines and show *late* and *less* marriage patterns to some extent. Generally, all of the survival curves gradually moved toward the right side over cohorts, which demonstrates the long-lasting marriage delay. However, it is still difficult to say whether and to what extent delayed marriage was made up later in the figure.

The lower graph (b) in Figure 3-3 illustrates the marriage P&R process over five-year birth cohorts. The figure was transformed from the survival curves into the differences in CFMR by age and from the 1916–1920 benchmark cohort. The *U*-shaped curves represent how each cohort's marriage schedule deviated from the benchmark. A descending slope on the left side represents a decline in CFMR in younger ages from the benchmark whereas an ascending slope on the right side illustrates the catching-up effect of delayed marriage in late ages. In graph (b), the *U*-shaped curve becomes deeper and wider over cohorts, implying that marriage delay intensified (deeper) while marriage recuperation was protracted (wider) over cohorts. The graph also demonstrates that marriage delay has continued over cohorts and that most delayed marriage was made up later, mainly in women's late 20s and early 30s. By and large, the universal marriage pattern remains in Korea despite the long-lasting marriage delay.

<Figure 3-3 is about here>

Figure 3-4 summarizes the key measures of the marriage P&R process observed in Figure 3-3: postponement (*P*), recuperation (*R*), recuperation index (*RI*), and decline in CMFR at age 45. The upper graph (a) is derived from the base model that uses a fixed benchmark while the lower graph (b) is based on a relational model using a moving benchmark. All of these measures are documented in Appendix 3-A.

In the graph (a) in Figure 3-4, marriage postponement (an absolute decline in CFMR at the trough age) has gradually increased over cohorts. The square mark, which indicates postponement (*P*), reached 0.840 for the latest 1976–1980 cohort without any decline. In other words, the difference in CFMR was greatest at age 22, which is 84%p lower than the benchmark. The bar plots represent absolute recuperation (*R*) in CFMR from the trough by selected ages (30, 35, and 45 here). These bars reveal how much delayed marriage was made up by these ages. The key measures in the relational model are also summarized and illustrated in the lower graph (b). Comparing the two graphs in Figure 3-4 helps to determine a clearer trend in the marriage P&R process.

As seen above, the postponement indicator (*P*) gradually increased from the 1912–1920 cohort to the latest 1976–1980 cohort. Marriage postponement rapidly increased between the 1931–1935 and 1941-1945 cohort and leveled off until the 1961–1965 cohort and then gradually increased afterwards. The recuperation index showed a near-complete recuperation effect until the 1956–1960 cohort, but began to depart from a complete catch-up from the 1961–1965 cohort and afterwards. As a result, the recuperation index ($RI = 100*R / P$) stayed around 95% in the base model and around 85% in the relational model. The trend line for the final decline in CFMR stayed near flat but rose slightly among the cohorts born in the 1970s in the base model.

It is notable that the postponement index suddenly became higher between the 1926–1930 and 1931–1935 cohorts. The rise in postponement continued until the 1941–1945 cohort and then stabilized in the following cohorts. The sudden rise in the postponement index through the 1931–1935 cohort to the 1941–1945 cohort was probably due to successive political turbulence in the 1940s and 1950s, which included World War II, liberation, and the Korean War. The wars and social unrest made young women delay their age of first marriage. An unbalanced sex ratio at the primary marriage ages due to wars might have also contributed to the delay. However, almost all marriage delays were made up later before the women reached their 30s, which contributed to the baby boom after the Korean War. Stabilized postponement soon after the shift of marriage timing suggests that the cohorts that followed the war adopted the changed marriage schedule. Consequently, the wars and unrest brought about a shift in women's marriage timing from the late teens to the early 20s, without a change in non-marriage.

Another substantive rise in the postponement index appeared for the cohorts born in and after the 1960s. The intensity of marriage postponement continuously increased while the recuperation index gradually declined. Whereas the marriage delay almost recuperated for the cohorts born before 1960, parts of the delay began to end with non-marriage, though it was still marginal. Interestingly, the 1961–1965 cohorts who experienced a marriage delay coincide with the cohort that first entered sub-replacement fertility in Korea (Yoo, 2014). The factors that caused low fertility, such as extended education, an increase in women's social participation, and economic uncertainty, might have also influenced marriage delay.

In short, marriage delay has continued through the entire cohorts observed in this study. In the context of long-lasting marriage delay, two substantive rises in marriage timing are noteworthy in Korea. The first major flow of marriage delay happened to women born in the 1930s and the early 1940s. The marriage postponement was remarkable, but non-marriage changed little due to a near-complete recuperation of delayed marriage. Political unrest and protracted destitution triggered the shift in women's marriage age from the late teens to the early 20s. The second flow happened to women born in and after the 1960s, who showed below replacement fertility. Marriage postponement gradually increased while recuperation began to decline. Furthermore, the divergence between marriage postponement and recuperation directly led to a rise in non-marriage. The two flows of marriage delay are distinct and contribute to the differences between the first and second demographic transition in Korea.

<Figure 3-4 is about here>

Difference in trends by level of education. The pattern of marriage P&R can be further divided by level of education. As described, I separated the pattern into two groups, the cohorts born before 1960 and the cohorts born in and after 1960. The marriage P&R process for the 1916–1920 and 1956–1960 cohorts does not differ much by level of education (Figure 3-5). The groups with "incomplete secondary" and "secondary and more" show minor fluctuations in marriage schedule among older cohorts born in the 1920s, but these are mainly due to relatively small group sizes for higher education. Except for that part, the marriage P&R process looks similar across levels of education until the 1956–1960 cohort. This suggests that the first flow of marriage delay, which was mainly caused by successive wars, affected all social groups of women indiscriminately. As the pattern is straightforward, I do not discuss it further here.

<Figure 3-5 is about here>

Figure 3-6 displays the dynamics of the marriage P&R process for the 1956–1960 and 1981–1985 cohorts. These cohorts commonly show sub-replacement fertility and benefited most from the expansion of higher education, which began in the 1980s. The 1956–1960 cohort is considered as a benchmark. I used four educational categories here: "incomplete secondary," "secondary completion," "some college," and "bachelor and more." By and large, the marriage P&R process looks similar across the four levels of education. The younger cohorts tend to delay marriage more and the majority of marriage delay was made up later. However, the extent and pace of recuperation differ slightly by level of education.

For women with incomplete secondary education, the marriage schedules gradually delay over cohorts while recuperation is also protracted. One of the salient features for the lowest educated is that the reversal of marriage delay appears among the latest cohort. The marriage schedule for the latest 1981–1985 cohort is higher than that of the 1976–1980 cohort, suggesting an advance in the marriage schedule. In a prior study (Park et al., 2013), the 1976–1980 cohort with incomplete secondary education showed the greatest marriage delay, even greater than the most educated. In contrast, the latest 1981–1985 cohort shows the reversal of marriage delay in this study. More cohorts need to be cumulated in order to understand whether this pattern is transient or systematic. Furthermore, since the share of the group is less than 5% for the cohort, the reversal of the marriage P&R among the least educated has a minimal impact.

Other educational groups show a similar pattern with different paces. The marriage P&R parabola becomes deeper and wider as they reach the latest cohort. The trough moved toward the right side, from the mid-20s for the 1961–1965 to the late-20s for the 1966–1970 cohort for all levels of education except for the least educated. The deeper troughs reflect growing marriage delay over cohorts while the drooping upward slopes represent extending recuperation. The protracted recuperation of delayed marriage increasingly results in non-marriage.

The marriage P&R process is still ongoing in all levels of education except for the least educated. The extent of postponement is most pronounced among the most educated, that is, women with bachelor’s degree or more: in the base model, it was 0.482

for the 1981–1985 cohort while other groups remain 0.378 or lower. The postponement index is positively associated with level of education except for the least educated. In contrast, the recuperation index (*RI*) varies with level of education although women with tertiary education—both “some college” and “bachelor or more”—reveal higher recuperation than others.

The marriage P&R process does not differ much by level of education until the cohorts born in the 1960s. For the cohorts born in and after the 1960s, however, the marriage P&R process starts to diversify by level of education although most groups still share the overall direction. The least educated women display the reversal from marriage delay while the most educated continue to show the greatest postponement and recuperation (in absolute value). As marriage delay continues while recuperation declines, there are enough grounds to expect the decline of universal marriage in the country.

<Figure 3-6 is about here>

Projection scenarios of cohort first marriage rate. The marriage P&R and variation across levels of education suggest that more drastic changes in marriage could emerge in the near future. To check the possible changes beforehand, I provided cohort projection scenarios of CFMRs at age 45 for the cohorts that pass the trough age in the analysis above. Key measures from the analysis were utilized to estimate the ongoing marriage P&R process.

In Figure 3-7, the upper graph (a) depicts the observed and projected CFMRs at women aged 45 for four different educational groups. Despite the decline in CFMR at age 45 since the 1956–1960 cohort, it never fell below 0.95 until the latest 1966–1970 cohort. This confirms a strong universal marriage tradition in Korea. Given the trends in the graph, nobody can deny that the CFMRs would decline further. However, the question is to what extent and how fast it would decline. Figure 3-7 includes four levels of education with two different projected lines for each: *stable RI* and *trend RI*. Note that all key indicators were based on the 1956–1960 benchmark.

The CFMR at age 45 declined in all levels of education. For instance, CFMRs were 0.94 or above in all levels of education for the 1956–1960 cohort but none of the projection scenarios stayed above 0.90 except for the least educated with *stable RI* (0.94). For the least educated, both projected lines (*stable RI* and *trend RI*) had a moderate decline first and then a slight rebound at the latest 1981–1985 cohort, which reflects the reversal from marriage delay as discussed above. Other educational groups shared clear downward trends, but both groups with tertiary education, “some college” and “bachelor or more,” stood out in pace. For example, the most educated (“bachelor or more”) with *trend RI* projects the greatest drop in CFMR—as low as 0.67 among the 1981–1985 cohort. The same group with *stable RI* projects a relatively moderate drop in CFMR, but it also reaches 0.82 for the latest cohort. Having a greater change in the marriage P&R process, the most educated had a wider range of projections than others.

In places like Korea where marriage delay continuously increases, *stable RI* and *trend RI* can both be considered extreme scenarios for projecting CFMRs for upcoming cohorts. As the projections take into account trends in both marriage delay (*P*) and the recuperation index (*RI*), an ultimate level of CFMRs at age 45 would not deviate much from either scenario, especially for the cohorts that already reached the trough.

These education-specific trends can be readily used for projecting CFMRs for all of the cohorts. The graph (b) in Figure 3-7 includes four different projection scenarios. Two of them are ordinary *stable RI* and *trend RI* projection scenarios from the base model with the 1956–1960 benchmark. The other two projection scenarios take into account both education-specific trends (*stable RI* and *trend RI*, respectively) and educational composition for the corresponding cohorts. To be specific, the education-specific trends estimated above were multiplied by educational compositions that were observed in 2010. The projection scenarios that are considered education-specific trends show a wider gap between *stable RI* and *trend RI*. These lines display lower levels of CFMR at age 45 than the ones that do not consider education. The difference is the greatest in the lower limit for the 1981–1985 cohort (0.47 vs 0.74). Given the educational variation in marriage P&R and the rapid change in composition in Korea, the new method based on education-specific trends could be better for projecting changes in CFMR for upcoming cohorts.

< Figure 3-7 is about here>

Discussion and Conclusion

Over the past decades, a delay in marriage has appeared in most developed countries. In European countries and the U.S., marriage delay is involved in a rise in non-marriage, cohabitation, and non-marital births, but there is a paucity of information on East Asia where long-term trends in marriage delay have also occurred. This study explores the marriage P&R process and how it differs by level of education by quantifying marriage delay and the extent of catching-up in late ages. This study also extends its attention to historical patterns to determine whether a recent pattern is distinctive and how it differs from previous patterns. By utilizing graphical illustrations, this study describes how women's marriage schedule has changed over the cohorts in Korea, as a case study of East Asian countries.

Marriage delay has continued through both first and second demographic transitions in Korea. There have been two substantive marriage delays. The first major delay appeared among women born in the 1930s and early 1940s, when they faced successive political turbulence from World War II, liberation, and the Korean War. In period, marriage delay was almost completely made up later during a postwar period, without a change in spinsterhood. However, this pattern eventually altered women's primary ages for first marriages—from late teens to early 20s. A noticeable marriage delay occurred again for cohorts born in and after the 1960s that eventually reached replacement fertility. This trend, which has continued, seems headed for a prolonged form. The extent of marriage delay has gradually increased while the extent of recuperation has become protracted and declined with regard to the latest cohorts. Marriage recuperation still remains strong, but the proportion of ever-married at the end of the reproductive span is clearly on the decrease.

Educational variation also distinguishes the ongoing process from the previous one. The marriage P&R process did not differ much across levels of education until the 1960 cohorts and then began to diverge across educational groups. For the cohorts born in and after the 1960s, the P&R process was the most pronounced among the most educated group, which displayed the greatest marriage delay and catching-up effect in absolute value. In contrast, the least educated group showed a reversal of marriage delay among the latest cohort, which deviates from the ordinary pattern. However, this reversal is negligible, as it comprised the smallest share of the overall population. Except for the least educated, women's education is positively associated with greater marriage delay, but recuperation varies with level of education. Projection scenarios based on trends suggest that future young cohorts could experience greater divergence in CFMR across levels of education. When such differentials and educational compositions are taken into account, it is estimated that the proportion of ever-married women at age 44, which has never gone below 0.95, could reach to 0.85 at least and to 0.47 at the greatest for the 1981–1985 cohort.

The findings of this study contribute to the literature. This study sheds light on the historical pattern of marriage delay in East Asia. I demonstrate that the recent development of marriage delay in Korea is not only different from its Western counterpart but it is also distinguished from the country's own prior experience. For instance, women's mean age at first marriage became similar or higher than European countries during the period when non-marriage was still rare. The absence of prevailing cohabitation and substantive marriage recuperation distinguish marriage delay in East Asian countries from that in Western countries. Marriage delay during the first demographic transition cannot be found in the European marriage pattern. Furthermore, the difference in marriage recuperation (near complete vs. partial recuperation) between the first and the second demographic transition has been overlooked in the literature. Such distinctions advance our understanding of demographic transitions and add narratives to the discussion about the multiple aspects of the second demographic transition and variation across regions (e.g., Lesthaeghe 2010; Sobotka 2008).

Understanding the marriage P&R process also helps to better project CFMRs in the near future. Drastic changes in marriage timing and variation across social statuses make it difficult to forecast how marriage patterns might change. In this study, the projections based on the marriage P&R process suggest a range of possible changes for upcoming young cohorts. Considering the educational variation as well as compositional changes improve both the reliability and validity of the projections.

This study also includes a few limitations. The measure of marriage postponement is subject to the benchmark cohort in the base model. Following the suggestions made by a prior study (Sobotka et al. 2011), this study set the earliest cohort available as a benchmark, regarding it as the beginning cohort of the transition. A different benchmark might lead to different trends in marriage delay, but it should not alter the results of this study. A relational model that uses an immediate previous cohort as a benchmark also supplemented the robustness issue. Furthermore, due to data limits, I am not able to investigate further about changes in marriage. Reasons for marriage delay and information on union formation other than marriage are not available. Additionally, I do not consider men's marriage in this study in order to focus on the relevance to fertility and nuptiality. Given the hypergamy tradition and the positive association between men's education and marriage, the least educated men are more likely to delay marriage and delayed marriage is less likely to be made up. Additional research on men's marriage will uncover a different mechanism for men's marriage delay and variation across social groups.

This study describes how the marriage delay has developed in Korea. The link between marriage delay and recuperation began to slacken among recent cohorts of women. Given trends in marriage delay, the share of non-marriage could increase to a greater extent in the near future. The collapse of universal marriage and greater variation across social groups may begin in earnest in a couple of decades. However, it is also doubtful whether cohabitation and non-marital births will spread in Korea as much as in Europe and if so, whether these trends will appear in the least educated or the most educated women. Furthermore, it is interesting to know whether the historic bimodal pattern of marriage delay in Korea is also observed in the rest of the East Asian countries. Answers to these questions will definitely contribute to our understanding of marriage timing and demographic transitions.

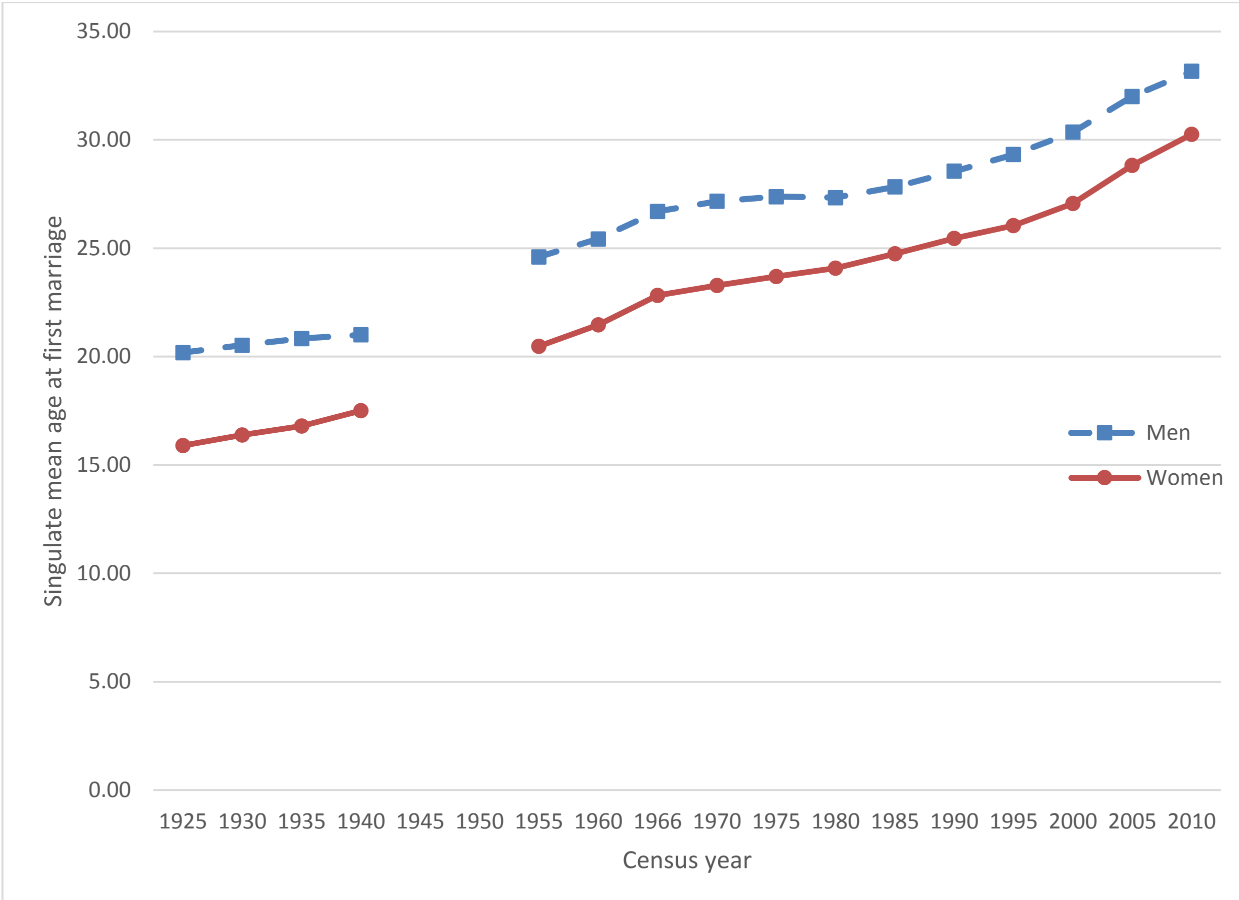
Table 3-1

Women's Marriage Postponement and Recuperation between the 1916–1920 Cohort and 1976–1980 Cohort

Birth Cohort	Postponement (*P*)	Age at Trough	Recuperation (*R*) at Age				Recuperation Index (*RI* = *R/P*)			
			30	35	40	45	30	35	40	45
a. Base model, compared to the 1916–1920 cohort										
c1916–1920	0.000	0	0.000	0.000	0.000	0.000				
c1921–1925	0.068	18	0.069	0.069	0.069	0.069	1.015	1.009	1.007	1.005
c1926–1930	0.102	19	0.099	0.101	0.102	0.102	0.979	0.999	1.006	1.002
c1931–1935	0.341	20	0.337	0.341	0.341	0.340	0.989	0.999	1.000	0.997
c1936–1940	0.504	20	0.493	0.502	0.503	0.502	0.979	0.997	0.999	0.997
c1941–1945	0.607	20	0.590	0.603	0.604	0.603	0.971	0.994	0.995	0.994
c1946–1950	0.652	21	0.609	0.635	0.640	0.642	0.935	0.975	0.983	0.985
c1951–1955	0.665	21	0.612	0.638	0.645	0.648	0.921	0.959	0.969	0.974
c1956–1960	0.718	21	0.639	0.681	0.692	0.696	0.890	0.948	0.964	0.969
c1961–1965	0.734	21	0.632	0.677	0.696	0.704	0.860	0.921	0.948	0.958
c1966–1970	0.787	21	0.633	0.703	0.730	0.741	0.804	0.893	0.928	0.942

c1971–1975	0.812	22	0.574	0.678	0.722		0.706	0.835	0.889	
c1976–1980	0.840	22	0.463	0.648			0.551	0.772		
b. Relational model, compared to the immediate previous five-year cohort										
c1916–1920	0.000	0	0.000	0.000	0.000	0.000				
c1921–1925	0.068	18	0.069	0.069	0.069	0.069	1.015	1.009	1.007	1.005
c1926–1930	0.046	21	0.043	0.045	0.046	0.046	0.931	0.985	1.001	0.996
c1931–1935	0.243	20	0.241	0.243	0.242	0.242	0.993	0.999	0.997	0.995
c1936–1940	0.169	21	0.163	0.168	0.169	0.169	0.962	0.994	0.999	0.996
c1941–1945	0.161	22	0.154	0.159	0.159	0.159	0.956	0.985	0.984	0.988
c1946–1950	0.059	22	0.034	0.046	0.050	0.053	0.574	0.783	0.855	0.893
c1951–1955	0.033	24	0.023	0.022	0.024	0.026	0.698	0.679	0.725	0.785
c1956–1960	0.073	23	0.047	0.063	0.068	0.068	0.638	0.858	0.923	0.928
c1961–1965	0.057	24	0.033	0.037	0.045	0.048	0.583	0.644	0.791	0.851
c1966–1970	0.104	25	0.052	0.077	0.085	0.089	0.506	0.745	0.820	0.855
c1971–1975	0.125	27	0.041	0.076	0.092		0.326	0.602	0.732	
c1976–1980	0.181	28	0.042	0.123			0.235	0.681		

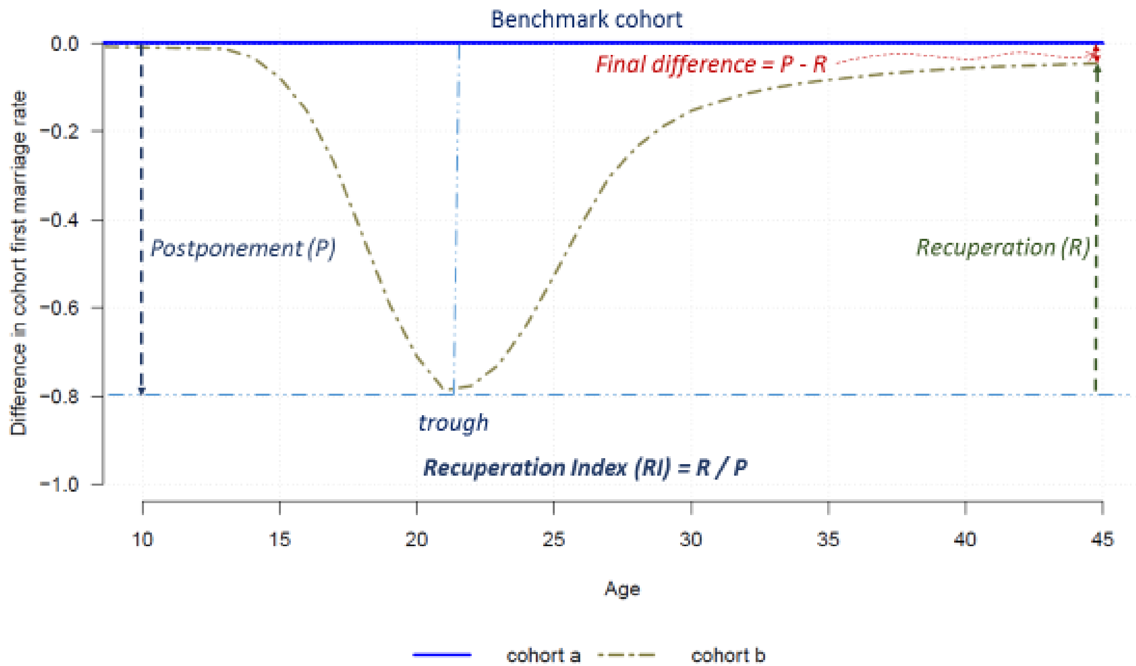
Figure 3-1. Singulate Mean Age at First Marriage for Men and Women, 1925-2010



Note: SMAMs for 1945 and 1955 are not available.

Source: Kwon (2005) for 1925–2005; Statistics Korea for 2010.

Figure 3-2: The Conceptual Illustration of Measuring Marriage Postponement (*P*), Recuperation (*R*), and Recuperation Index (*RI*).



Source: Frejka (2012) and Sobotka et al. (2011).

Figure 3-3. Change in Women's Marriage Timing between the 1916–1920 Cohort and the 1976–1980 Cohort.

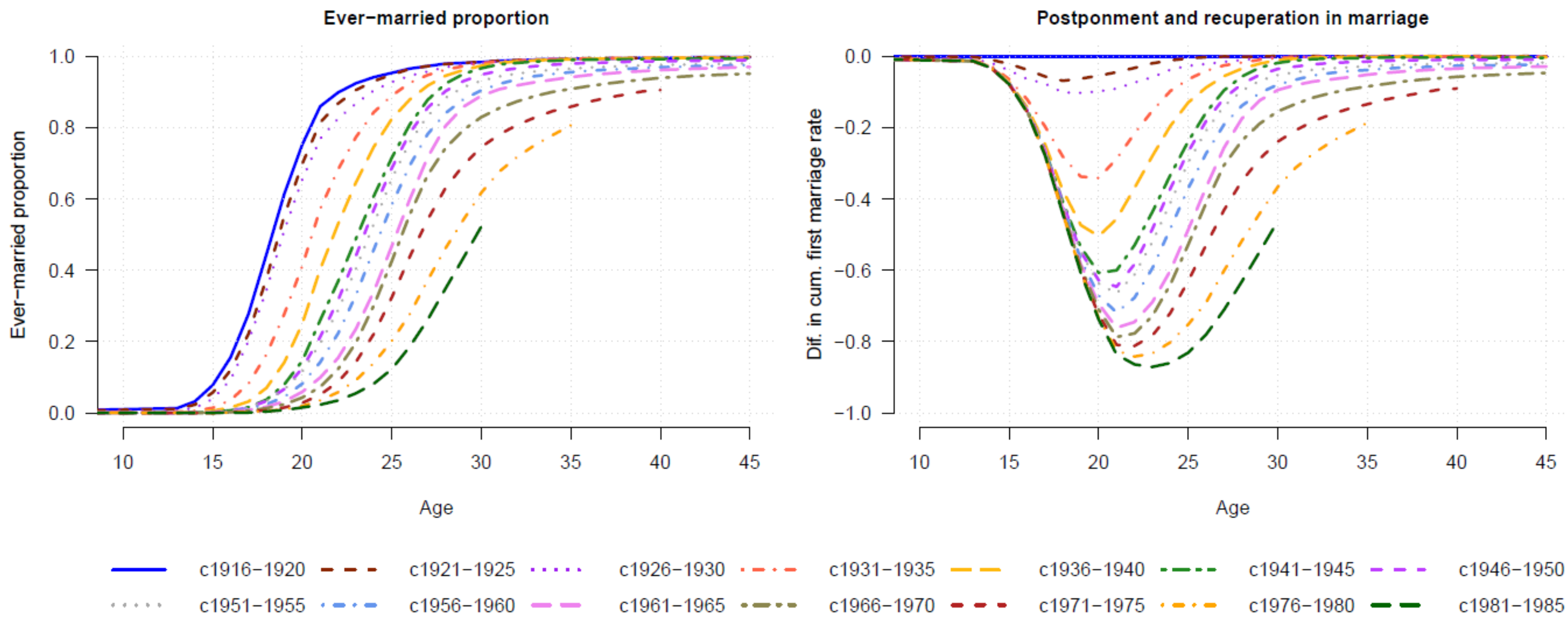
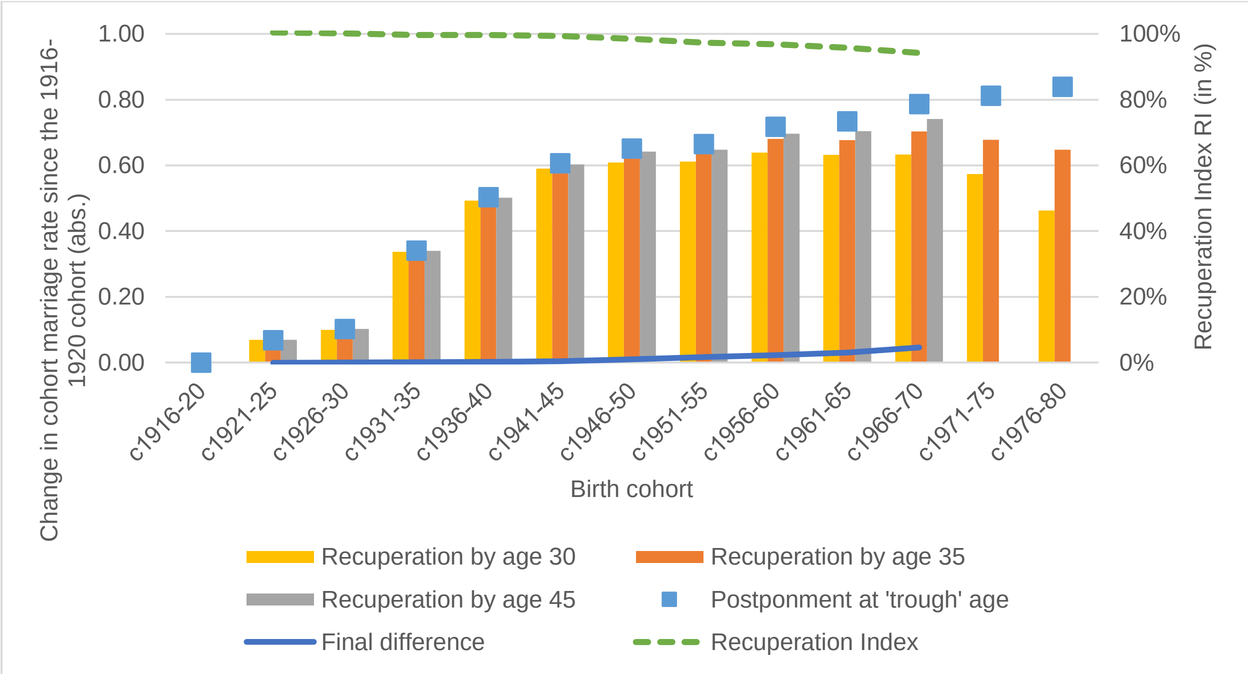


Figure 3-4. Graphical Summary of the Marriage Postponement and Recuperation between the 1916–1920 Cohort and the 1976–1980 Cohort, South Korea.

a. Base model



b. Relational model

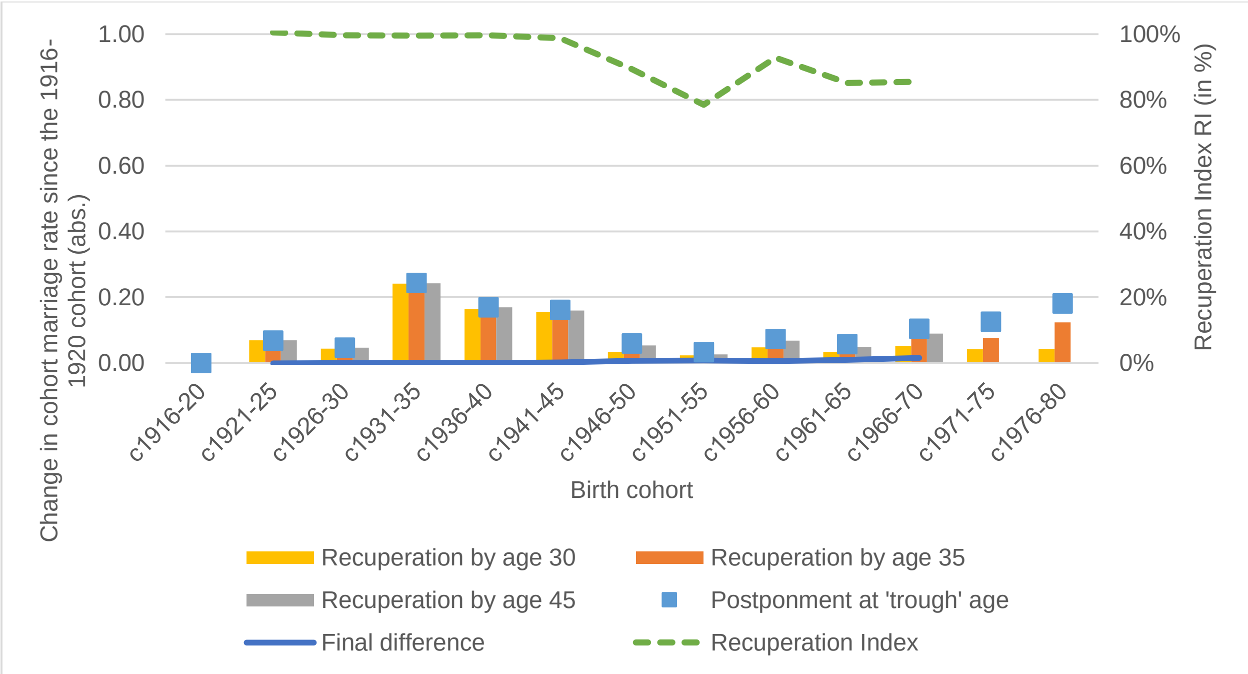


Figure 3-5. Marriage Postponement and Recuperation by Level of Education between the 1916–1920 Cohort and the 1956–1960 Cohort, South Korea.

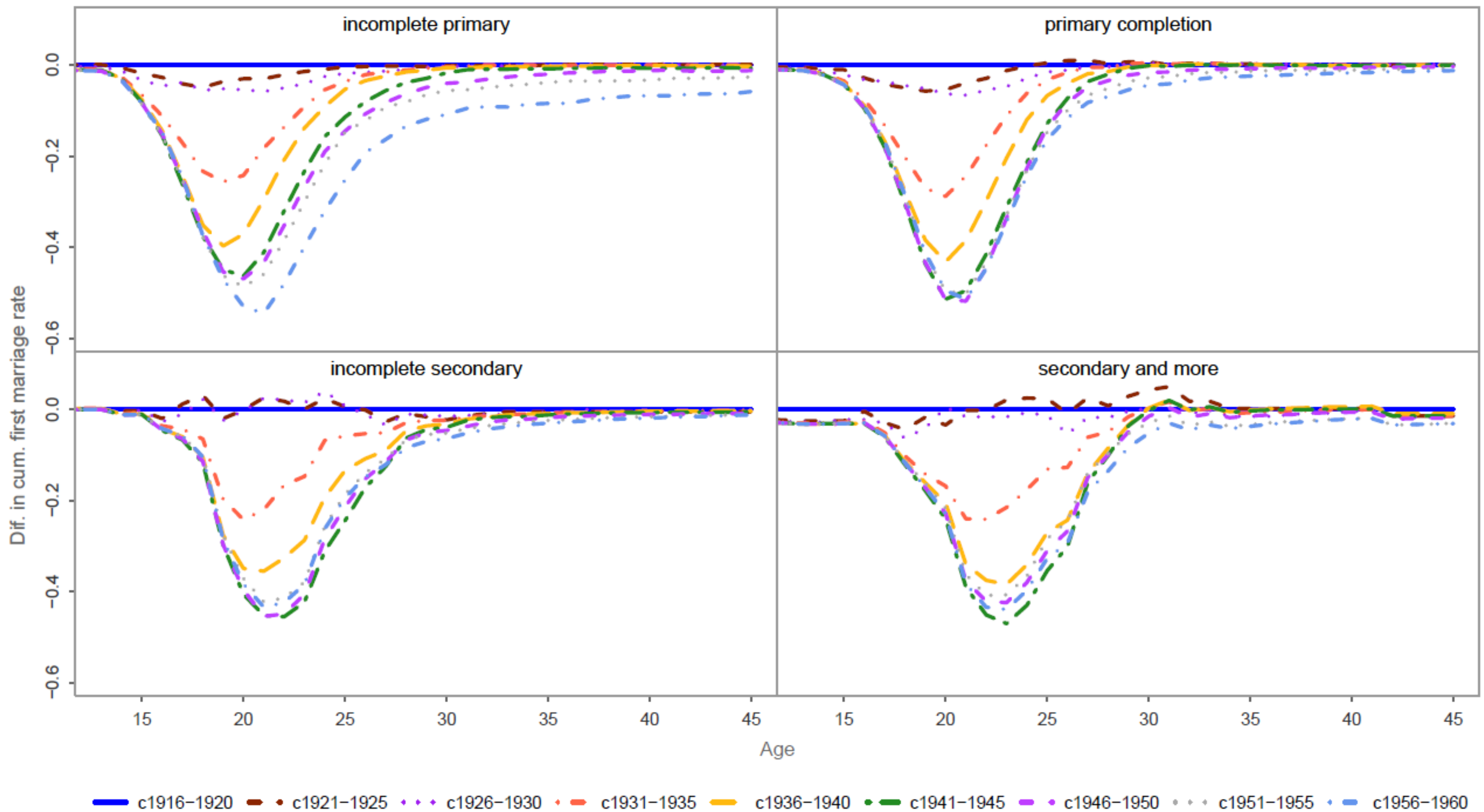


Figure 3-6. Marriage Postponement and Recuperation by Level of Education between the 1956–1960 Cohort and the 1981–1985 Cohort, South Korea.

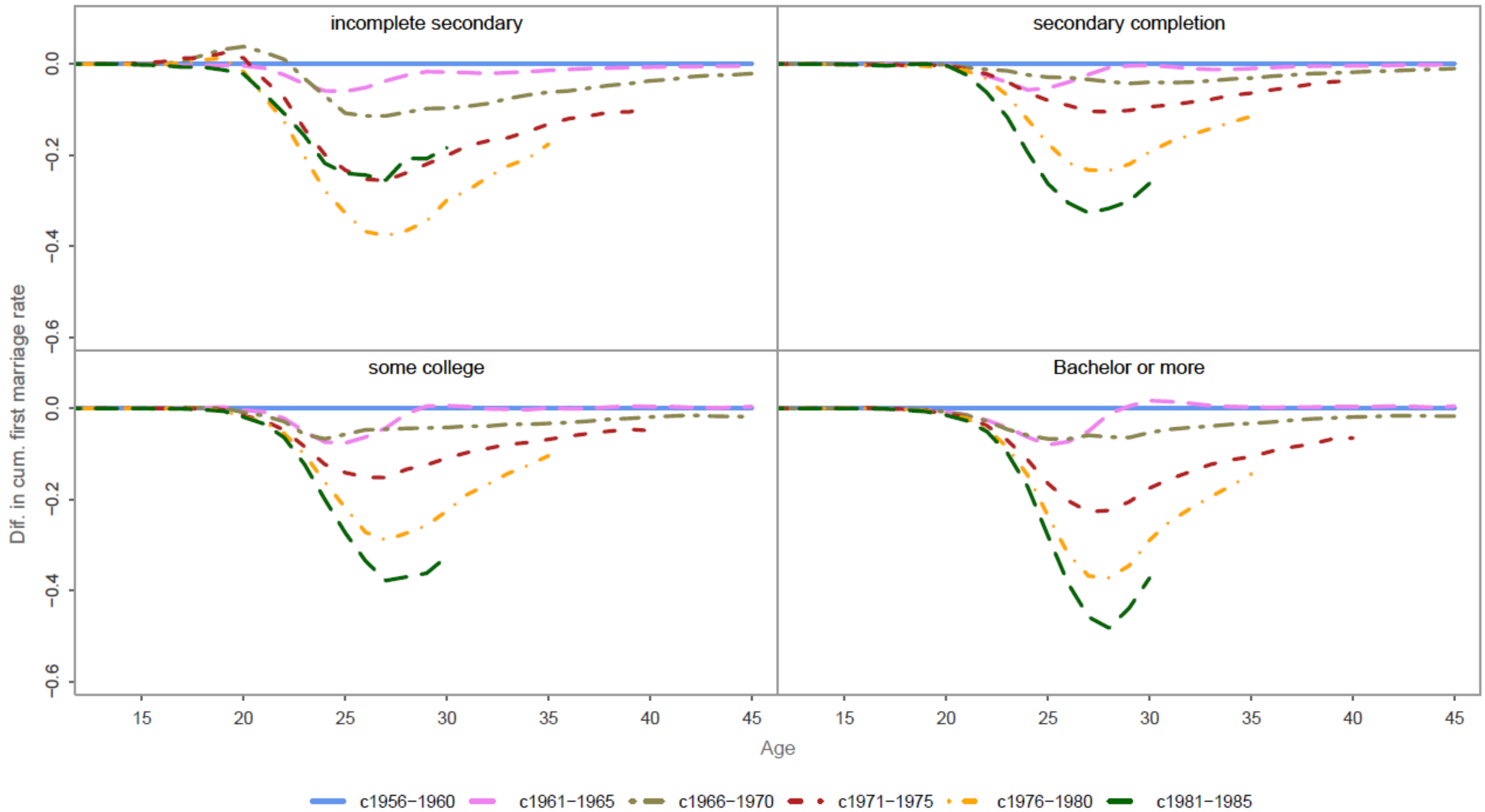
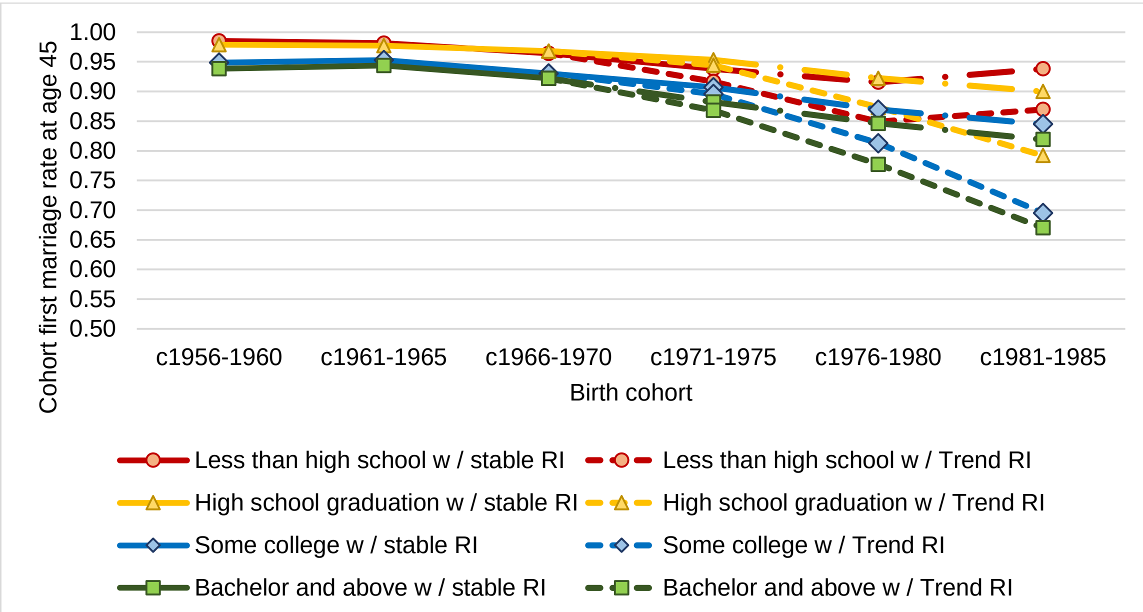
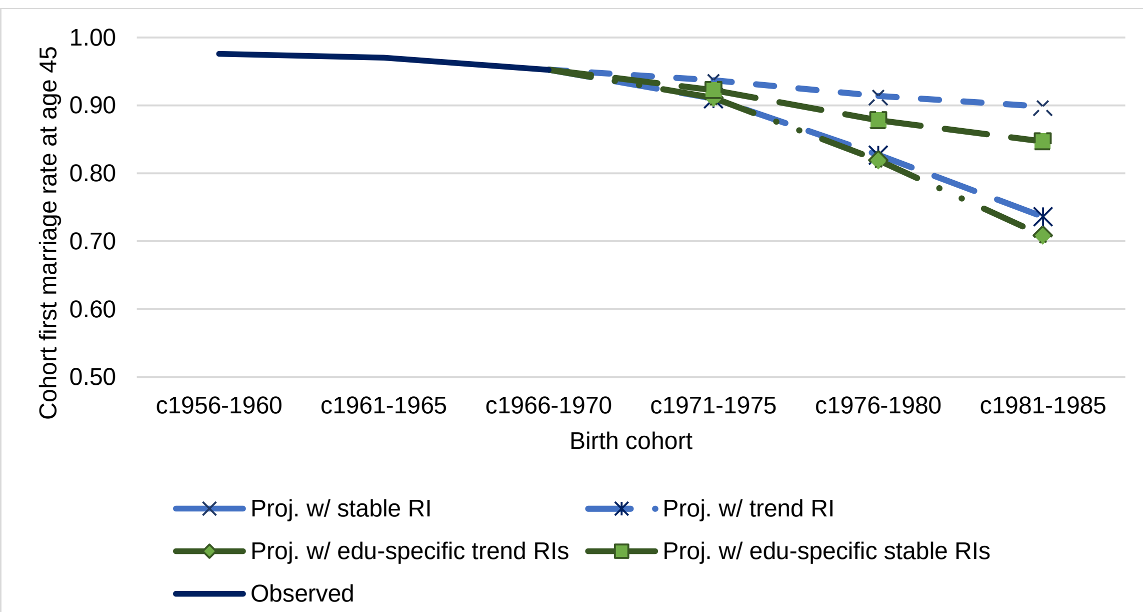


Figure 3-7. Projection Scenarios with Stable RI and Trend RI for Cohort First Marriage Rate (Ever-Married) at Age 45 to the 1981–1984 Cohort of Women.

a. Education-specific projection scenarios with *stable RI* and *trend RI*



b. Projection scenarios for the entire cohort, w/ and w/o education-specific trends



CHAPTER 4

FERTILITY CONCENTRATION

Introduction

Reproductive concentration indicates the extent to which childbearing is unequally distributed within women in a population. The unequal distribution of childbearing, which always exists due to heterogeneity in fertility preferences and behaviors, can cause compositional changes of population in ethnicity, religiosity, and social status and may result in considerable changes in political influence (Hout, Greeley, & Wilde, 2001; Kaufmann, Goujon, & Skirbekk, 2012). The consequences of reproductive concentration are also linked to socioeconomic variations such as changes in kinship support for the elderly, housing demand, consumer goods, social mobility, and socialization (Lutz 1989). For instance, the rise in childless women may increase the demand for a better social security system that compliments kinship support for the elderly. In a scenario in which childbearing is increasingly concentrated in a certain subpopulation, inequality issues can also arise with regard to child-rearing, which requires considerable time, effort, and resources. As in most cases, fertility is negatively associated with social status, that is, women with a lower social status are more likely to have many children, which could cause the burden of child-rearing to deteriorate their already-inferior status and is likely to transfer over generations (Mare, 1997).

As fertility falls below replacement level, parity distribution has more implications than ever before. In most societies, low fertility is accompanied by an increasing share of childless women, which contributes to the unequal distribution of childbearing. Increasing childlessness not only leads to the unequal burden of child-rearing but also is related to reproducing generations. An increase in childless women implies that the average number of children among mothers, which excludes childless women, paradoxically increases. That is, the gap in the average number of children ever born between mothers (without childlessness) and women (with childlessness) increases with the rise in childless women. Childless women literally do not reproduce children who can contribute to the next generation. As mothers' fertility is transmitted to daughters' family size, children that grow up with more siblings in childhood may have a higher family size than their mothers' generation—including childless women— even if the mothers' generation has low fertility (Lutz 1989). Depending on parity distribution and the correlation of fertility levels between mothers and daughters, this aspect may have a positive impact on improving low fertility or at least delaying further decline (Lutz, Skirbekk, & Testa, 2006).

Despite the significance and possible policy implications, there is a dearth of literature on reproductive concentration. Research on reproductive concentration usually measures the unequal distribution of childbearing and examines how it changes over cohorts (Lichter & Wooton, 2005; Lutz 1989; Shkolnikov, Andreev, Houle, & Vaupel, 2007; Spielauer, 2005; Vaupel & Goodwin, 1987). Interest in childbearing inequality later extended to comparative studies such as whether reproductive inequality increases across countries (Dorius 2008; Giroux, Eloundou-Enyegue, & Lichter 2008). However, these studies are not well connected to each other and main outcomes are also inconsistent across studies. Research on inequality across countries has also used period fertility rates that were conducted with arguable or contestable methods.[6] Interestingly, most studies rely heavily on the Lorenz curve to measure the unequal distribution of childbearing, but this raises a question of whether the measure, which is taken from economics, is appropriate for the analysis of parity distribution (Barakat, 2014). Furthermore, the literature mainly focuses on European countries and the U.S., or available data from developing countries (e.g., the Demographic Health Survey) to find a generalized pattern without considering regional contexts. In such a discussion, countries in East Asia like South Korea, which has experienced rapid fertility decline and socioeconomic changes in the past decades, have been missed.

This study explores reproductive concentration in South Korea. The country has experienced rapid fertility decline in the past decades and is currently under the lowest-low level of fertility. The marked decline in fertility along with recent low fertility make the country a better place for studying the dynamic relationship between level and concentration of fertility. Building on prior studies, this study applies three measures of reproductive concentration (the concentration ratio, the Kolm index, and statistical

---

[6] For instance, Giroux and colleagues (2008: 189) utilized the coefficient variance (CV) for fertility inequality, which is obtained from Firebaugh (1999). According to their description, $CV^2 = [\sum_i^k w_i(1-r_i)^2]$, w_i indicates the relative size of education groups, i indexes education groups and represents the ratio of the group's total fertility rates to the national rates. However, based on the original form of income inequality in Firebaugh (1999: 1623), $CV^2 = (1/N)\sum_i(1-r)^2$, N indicates the number of ranked income groups, and thus should be the number of parity groups in a parity context instead of educational groups. The w_i in Giroux et al. (2008) seems due to a misinterpretation of the $1/N$.

dispersion) to South Korea, as a representative case of the developing countries outside Europe. In this study, I first review the trends of reproductive concentration over cohorts and test the applicability of the three measures. I then examine the relationship between the level and concentration of fertility and its variation across levels of education and find a non-linear relationship. The merit and faults of the three concentration measures are also discussed. This study contributes to our understanding of unequal distribution of childbearing by adding empirical evidence on the association between level and concentration of fertility to the literature.

Reproductive Concentration and Measures

Reproductive concentration represents how much the number of children is unequally distributed in a group of women, mostly in a birth cohort. Vaupel and Goodwin (1987) first introduced the measure[7] using a Lorenz curve to measure the proportion of women that have half of the children (*have-half*). The concentration ratio (CR), which is frequently used as a measure of income inequality in economics, is measured by the ratio of the Lorenz curve over the area under the diagonal when the cumulative proportion of women is plotted over the cumulative proportion of children in a parity context. In their analysis of the U.S., the CR was relatively high in the early twentieth century due to the coexistence of higher fertility and a higher share of childlessness and then began to decline when the cohorts born in the 1920s and 1930s entered the baby boom. The

[7] The term of reproductive concentration also differs by studies. While most studies use "reproductive concentration" and "fertility concentration," a few studies also use "fertility inequality" and "fertility dispersion." This study does not distinguish these terms and uses them interchangeably.

introduction of the CR sheds light on qualitative aspects of quantitative parity distribution, which had not received much previous attention. Research interest in fertility concentration has intermittently continued, but findings have been ambiguous and have taken several directions: descriptive findings (Lichter & Wooton, 2005), fertility inequality across countries (Dorius, 2008; Giroux, Eloundou-Enyegue, & Lichter, 2008), and seeking general patterns with regard to fertility level, education, and others (Barakat, 2014; Lutz, 1987; Shkolnikov et al., 2007; Spielauer, 2005). The majority of these studies employed the CR, which is essentially equivalent to the *Gini* coefficient in economics. Questioning the propriety of using the *Gini* coefficient in a parity context, a few studies also utilized different measures of fertility concentration, such as the absolute index of inequality and variance (Barakat, 2014; Dorius, 2008; Giroux et al., 2008). However, there is no agreement on the measures of fertility concentration despite the significance of in-depth discussions of fertility concentration.

Major research outcomes are also mixed and, as yet, inconclusive. A main question in the literature is whether fertility concentration is patterned by level of fertility. With the World Fertility Surveys, Lutz (1989) found that the CR is negatively associated with level of fertility in most countries except for China.[8] In his analysis, the CR tended to increase with fertility decline in most places, while it exceptionally leveled off in China. However, subsequent studies did not support the negative association between level and concentration of fertility. For instance, the CR has decreased with fertility

[8] He also explains that unlike other countries, strong family planning programs and the one-child policy in China might have an "egalitarian" impact on parity distribution.

decline since the post-war baby boom period in most European countries and rebounded recently as the number of childless women has risen in these countries (Shkolnikov et al., 2007; Spielauer, 2005).

The association between level and concentration of fertility is often further expanded into variation across social classes. Lutz (1989) argued that the negative association between the two is robust across social statuses, such as regions (urban and rural) and educational groups. That is, any group with higher fertility shows a lower level of fertility concentration. For example, educated groups tend to have lower fertility than others, which, in turn, is connected to a higher CR level. Recent research, however, reports that the association between the CR and women's education is inconsistent across European countries (Shkolnikov et al., 2007). Specifically, the CR was the highest among the most educated group of women in Western countries whereas the opposite was the case in Eastern European countries. In particular, the CR rise was the greatest among the most educated for recent cohorts in Austria, probably due to the rise in childless women for the corresponding group (Spielauer, 2005). These inconsistencies across studies might be attributed to differences in data, area, period, or sample population. For instance, Lutz's analysis was based on maternal fertility data from developing countries. In contrast, latter studies have focused on European countries that are mostly in late- or post-transitional stages. Such differences in contextual effects, along with the gaps in fertility levels, interrupt identifying an actual aspect of the association between level and concentration of fertility. However, a fundamental problem might also exist on the measures of fertility concentration as well.

The CR was originally designed to measure the "relative" inequality of income distribution. As the number of children is a count data, parity distribution is essentially different from income distribution and thus cannot be regarded as the same unit. Perhaps the debates on the association between level and concentration of fertility might be built on a weak foundation. Barakat (2014) pointed out the misapplication of the income inequality measure to the parity distribution in the literature. In a parity context, the *relative* difference between having one child and having three children cannot be comparable to the difference between having two children and having six children. The existence of childlessness also makes the concentration of fertility distinct from income distribution. Consequently, Barakat introduced the absolute index of inequality (Kolm index) and statistical dispersion (variance-to-mean ratio), suggesting that using three different measures of concentration can provide multidimensional aspects of fertility concentration that complement each other.

The Kolm index is one of absolute inequality measures (Kolm, 1976a; 1976b). It is invariant to an extra unit change in everyone's income, which is also said to be *translation invariant*. Simply, the index regards the difference between having two children and having three children as the same difference between having one child and having two children. Such an index is based on an *absolute* difference, rather than a *relative* difference and therefore is considered more appropriate for count data. The index of statistical dispersion, which is called a variance-to-mean ratio (VMR), is also appropriate for count data. The VMR is actually used to describe whether the distribution is over-, equi-, or under-dispersed in the reference to the given mean of Poisson distribution. Roughly speaking, *over-dispersion* indicates the distribution is more concentrated than the theorized (Poisson) distribution for the mean while *under-dispersion* implies the distribution is less concentrated. Strictly speaking, the VMR is a measure of dispersion, but can also be interpreted as the extent of concentration for the mean.

Barakat (2014) found that any of the three concentration measures has a non-linear relationship with the level of fertility. For instance, the trends in VMR have a cubic relationship, more precisely as a “slanted *S*-shaped” pattern, with fertility level. From pre-transitional stages to the post-transitional stages of low fertility, the statistical dispersion as a measure of fertility concentration moved from equi-dispersion (VMR=1) to over-dispersion (VMR>1) with a peak around fertility of 4–5. It then dropped to under-dispersion (VMR<1) until around the sub-replacement level and then rebounded to equi-dispersion in very low fertility. Such *S*-shaped trends were also observed in the two other measures of fertility concentration—the CR and the Kolm index. However, the *S*-shaped trend is the first argument about a non-linear relationship between the level and concentration of fertility. Despite compelling trends in fertility concentration, the interpretation that both the beginning and end of changes would converge around the equi-dispersion is also arbitrary and superficial.

Accordingly, literature on fertility concentration has not yet been well established and therefore needs further investigation. The primary measure of concentration, the CR, is incomplete and reflects only a part of fertility concentration. Utilizing three measures of concentration together can be a useful alternative but this approach has only been applied in a single study. Furthermore, the countries that were examined in prior studies tend to be biased toward European countries and the U.S. Although a set of developing countries was included in the aggregate-level analysis, regional variations and country-specific contexts were mainly overlooked. Research out of Western countries is definitely lacking. In addition, few scholars often collect empirical data from many different countries and use it to detect global trends. However, the collection of fragments does not necessarily represent the whole picture. For instance, the experience of demographic transition in Western countries, which has taken a couple of centuries, is far different from that of developing countries out of Europe; that is, the latter is much more intense and compressed. It is doubtful whether the findings based on Western countries would be replicated in other countries even if fertility rates reach a similar level. In this sense, empirical data that spans the period from the pre-transitional to post-transitional stage of very low fertility could be a great contribution to discussions on fertility concentration.

This study explores fertility concentration in Korea. Taking advantage of an extensive span of cohort data, I investigate the trends in fertility concentration and a variation with the level of fertility over the demographic transition. Specifically, I look at how fertility concentration has changed over the women of cohorts born between 1921 and 1970. I then discuss the merits and faults of the three measures— the CR, the Kolm index, and VMR. I also examine the relationship between level and concentration of fertility, whether there is any general pattern and if so, how it differs by level of education. This study also tests whether previous study trends found in Western nations are replicated in the context of East Asia. Since the process of fertility decline in Korea was already described in Chapter 2, I do not repeat it. Furthermore, I also use the same analytic data with in this chapter, the only difference being that I add the 1966 census into the data to secure more cohorts that cover the pre-transitional stage. Thus, the analyzed cohorts in this study include women born between 1921 and 1925. Country background and data description can be found in Chapter 2.

Three Measures of Fertility Concentration

Following prior research (Barakat, 2014), I considered three different but closely related measures of fertility concentration—the CR, Kolm index, and VMR. As mentioned, the CR is based on the Lorenz curve. The cumulative number of women is placed on an x-axis in a reverse order of birth parity from the highest to childlessness while the cumulative number of children is located on a y-axis. The ratio of the area between the Lorenz curve and the diagonal over the one under the diagonal becomes the CR (see Shkolnikov et al., 2007 for further details). The CR is scale invariant, which indicates that it does not change when proportionally equivalent births are added into the existing parity (Barakat, 2014). As a result, the CR can be interpreted as relative inequality of childbearing distribution; the difference between having one child and having two children is regarded as the same difference between having two children and having four children. Previous studies have also utilized *havehalf* and *halfhave,* that is, determining the proportion of women who have half of the children and what proportion of children have half of the women. Both measures, *havehalf* and *halfhave*, are derived from the intersection of the Lorenz curve with the horizontal and vertical lines of 50 percentiles, respectively. As these measures are highly correlated with the CR, it is better to consider these as two CR variants rather than independent ones. For that reason, I did not consider the two measures separately and just focused on the CR in this study in order to simplify the analysis and to avoid unnecessary confusion.

The second measure is the Kolm index, which represents an absolute level of unequal distribution of childbearing. Simply, it measures the difference in number of parities from the mean. Unlike the CR, this index considers the difference between childlessness and having a child as the equal difference between having a child and having two children. It is translation invariant and thus often preferred for count data (Barakat, 2014). The Kolm index of inequality is defined as:

$$K_\alpha(X) = \frac{1}{\alpha} log(\frac{1}{n}\sum_{i=1}^{n} e^{\alpha(\bar{X}-X_i)}).$$

In the formula, α indicates the degree of sensitivity to inequality. This study also sets α = 0.1 as in the previous study (Barakat, 2014). X_i indicates the number of parity for *i*th individual.

Lastly, I also considered VMR as a measure of fertility consideration. VMR is an index of statistical dispersion and thus represents whether the variation is over-dispersed, equi-dispersed, or under-dispersed. Compared with the other two measures, VMR is easily measured with the mean and variance only. As the VMR is originally designed for Poisson distribution, it also fits well with the distinctive features of parity distribution. VMR is 1 for the Poisson distribution, but could vary with the form of distribution in a parity context. Simply, VMR represents the extent of fertility concentration for a corresponding level of fertility. With these measures of concentration, I explored fertility concentration in Korea according to the following criteria: (1) periodic changes, (2) the association with level of fertility, and (3) the association with level of education. I first reviewed how fertility concentration has changed over 50-year cohorts, from the 1921 cohort to the 1970 cohort. Then, I contrasted the change in fertility concentration over the level of fertility. The association between level and concentration of fertility can be manifested with more cases. Thus, I also disaggregated each cohort into six different educational groups and examined the association between level and concentration of fertility. The last section of the analysis examines how the association differs by women's levels of education. The six educational categories, which cover the rapid transition in women's educational attainment in Korea, include "less than primary," "primary," "lower secondary," "upper secondary," "some college," and "bachelor or higher," as in Chapter 2. Some educational groups are very small in some cohorts. To avoid possible bias caused by small sample size, I used five-year birth cohort, instead of a single-year cohort, as far as educational variation is concerned. Furthermore, educational groups that occupy less than 1% of the corresponding cohort were not represented for the same reason. The analysis with three different measures of concentration not only provides different perspectives on fertility concentration but also offers an opportunity to test the pros and cons of the measures.

Results

Trends in fertility concentration and underestimation. In general, complete parity distribution is positively skewed as women with extreme numbers of children always exist in most societies. In such cases, high-order births are often censored and aggregated at the highest available parity and parity distribution is expressed in an abridged table. For instance, the Human Fertility Database, the online database of fertility data, uses six categories for parity distribution from childlessness to the fifth parity and higher; in turn, women with five children or more are grouped together into "parity 5+." For many developed countries with low fertility, censoring and grouping high-order births have negligible effects on computing fertility rates and fertility concentration because few women have more than five children in such settings. For developing countries with high fertility, however, such grouping could lead to biased results in the level and concentration of fertility, which would subject to the highest category for the parity average number of children for the category. Grouping high-birth parities around four or five can mislead fertility concentration in high fertility countries.

Here, I briefly demonstrate this with the case of Korea. Completed cohort fertility has steadily declined over the female cohorts born between 1921 and 1970 (Figure 4-2). The cohort fertility was 5.75 among women born in 1921 but reached sub-replacement level for those born in the late 1950s and then further declined to 1.73 among those born in 1970. As a result, completed fertility has declined by more than one-third for the last 50-year birth cohorts. The marked decline in fertility implies that fewer and fewer women reach high-order parities, and in turn, contribute to the decline in fertility concentration.

< Figure 4-2 is about here >

Figure 4-3 illustrates the underestimation of both the CR and the Kolm index, in which higher order births are aggregated. VMR is not shown as it does not necessarily require the highest parity for the computation. In both figures of the CR and the Kolm index, the uppermost solid line represents trends in fertility concentration using the complete parity distribution. Compared to the solid line of the complete distribution, the dotted lines for the abridged distributions show lower fertility concentrations for the old cohorts with high fertility. The gaps across lines are more pronounced among women born in the 1920s and 1930s. The extent of underestimation increases as more parity is aggregated. The dotted lines of the abridged distributions tend to converge to the solid line in which only a marginal number of women fall into the highest category.

A tendency to underestimate can be misleading in determining the trends in fertility concentration over cohorts. For instance, the CR moderately declined over birth cohorts despite a slight increase among recent cohorts. However, that could be differently interpreted as a rising trend if parity 4+ or parity 5+ was used as the highest category. The bias caused by aggregating higher parity makes it difficult to identify the actual trends in fertility concentration and the relationship with other factors like fertility rates and level of education. Figure 4-3 points to the need for reexamining the relationship between fertility concentration and other variables because some studies using the CR were built on abridged parity distributions. Furthermore, this indicates that a chance always exists for underestimation of fertility concentration when research utilizes samples data. Since the range of sample distribution is narrower than that of population distribution, fertility concentration based on survey samples is more likely to be underestimated although it might be negligible.

Figure 4-4 represents the trends in three measures of fertility concentration (CR, Kolm index, and VMR) over the cohorts born between 1921 and 1970. All three measures share descending trends although the patterns differ slightly. Fertility concentration has declined through the entire cohorts but showed signs of a reversal among recent cohorts born in the mid-1960s and after. To be specific, CR trends maintain a very moderate gradient until the 1960 cohort and show a slight rise near the end. The fluctuated slope of the CR, which is close to a rugged plain, is in contrast to a monotonic decline in other two measures of concentration. The moderate fluctuations in the CR are evidence that the measure is sensitive to the change in parity distribution. The reversal of the trend around the 1960 cohort, followed by the rise in the CR, reflects an increasing share of childless women among recent birth cohorts in the context of low fertility. That reversal also happened almost simultaneously with the entry into the sub-replacement level of cohort fertility around the 1960 cohort. Taken together, as a relative index of inequality, the CR is more elastic than the other two measures in illustrating the rise in childless women, as well as the change in parity distribution.

Both the Kolm index and the VMR show very similar trends, but the VMR points more upwards at the right end. As the Kolm index is based on absolute differences, minor changes in parity distribution in a low fertility context scarcely influence the index. The Kolm index is thus relatively very stable over cohorts as well as less sensitive to the rise in childlessness than other measures. Nonetheless, the Kolm index clearly shows that the absolute level of fertility concentration has continuously declined for the observed cohorts. The VMR also confirms what other measures showed: the variance of parity distribution was over-dispersed for the cohorts born in the early 1920s but soon became under-dispersed and continued to decline. The extent of under-dispersion has intensified over cohorts but began to show signs of rebound around the cohorts born in the 1960s. The pattern is consistent with that of the CR although the reversal around the end has a more restrained form.

The relationship between level and concentration of fertility. The relationship between level and concentration of fertility, which is one of the main interests of this study, is illustrated in Figure 4-5. As completed cohort fertility has monotonic declining trends over cohorts, Figure 4-5 showing the three measures is bilaterally symmetric with Figure 4-4, which reveals cohort changes. In Figure 4-5, the CR graph (a) does not show any clear pattern. From right to the left on the graph, the CRs slightly declined first (completed fertility between 5 and 6) leveled off (between 2.5 and 5), declined again until the sub-replacement level, and then began to surge under the replacement level. Due to the drastic and frequent changes of the CR, it is difficult to define the relationship with regard to the level of fertility because neither a linear nor a quadratic line fits the trends. Roughly speaking, however, the figure suggests that the CR is positively associated with fertility decline overall until the replacement level of fertility, and then turned into a negative association in settings with low fertility.

The two other measures of concentration, the Kolm index and the VMR, show a clearer pattern against the level of fertility. In Figure 4-5, the two measures (b and c) are positively associated with the level of fertility at a glance. Fertility concentration clearly decreased with fertility decline and the only difference appeared around sub-replacement level of fertility. The Kolm index was congested and stagnant at the sub-replacement level and lost its direction whereas the VMR clearly showed a recovery track around the same point. The obvious contrast between the two measures demonstrates a rise in fertility concentration, according to an increase in childlessness, which was negligible in the perspective of absolute inequality.

The patterns in Figure 4-5 become clearer if more cases are secured. I disaggregated each cohort into six educational groups and plot the exact same figure into Figure 4-6. For a better-fitted line, I dropped educational groups that occupied less than 1% for each cohort as mentioned before. Figure 4-6 essentially displays the same pattern shown in Figure 4-5, but it also provides a different view about the relationship with the level of fertility. In the first graph, the CRs gradually declined as fertility declined but then soared around the sub-replacement level. However, again, it is hard to find any particular pattern with the level of fertility. The range of variation around the replacement level well reflects the CR sensitivity to the change in childlessness. For both the Kolm index and the VMR, the positive slope wanes as fertility reaches around the cohort fertility of 1.9 and eventually becomes a negative association with the level of fertility. Both measures display a quadratic relationship, rather than a linear relationship, with the level of fertility. The trends show the right side of the parabola only, which is closer to a *J*-shaped pattern with the vertex around completed fertility of 1.8–1.9. The quadratic trends also have more explanatory power than the linear ones in both graphs.

Among the three measures of fertility concentration, the drastic and frequent changes in the CR trends are distinguishable from the other two measures. The CR trends are more sensitive to changes in parity distribution whereas the Kolm index trends are less sensitive, particularly in the context of low fertility. One aspect in common across the three measures is that fertility concentration has a positive association with the level of fertility overall, but the association turns around in the sub-replacement level of fertility toward a negative association. The dynamic change in the trends supports an argument that fertility concentration has a non-linear relationship with fertility level, as a prior study suggested (Barakat, 2014).

Educational variation in fertility concentration. Another research question is whether fertility concentration differs by level of education, that is, whether fertility concentration is higher among more educated groups. Educational groups that occupy marginal share (less than 1%) for the corresponding cohort, were omitted here. Figure 4-7 illustrates education-specific concentration measures over birth cohorts during the fertility transition in Korea. The negative relationship between fertility concentration and level of education, which has been claimed in the literature, is not observed in Figure 4-7. Rather, the most educated group, “bachelor degree or more,” generally shows the lowest concentration across the three measures. However, the negative association between fertility concentration and education also shows signs of change. Two groups of tertiary education, “some college” and “bachelor or more,” show a slightly higher concentration than the “higher secondary” group among the cohorts born in the 1960s, which is probably due to the increasing share of childless women for those with higher education.

Education-specific concentration is drawn against the level of fertility in Figure 4-8. As seen above, a quadratic relationship is assumed for all levels of education and presented as a dotted trend line in each graph. In the concentration ratio graph (a), the trends vary with level of education. The vertexes of the quadratic lines spread through different levels of fertility while all slopes change from a positive to a negative direction as fertility declines in all educational groups. In contrast, the Kolm index graph (b) shows a coherent pattern across educational groups. Although all trend lines commonly represent the right part of the parabolas in the graph, the vertexes tend to converge around the completed fertility of 1.9.

Interestingly, the VMR graph (c) is located between the CR and the Kolm index. As in other graphs, the highest educational group displays the lowest concentration, but no regular pattern is found with regard to the education-level relationship. It is notable that the higher educational groups tend to have a steeper slope than others. In other words, more educated groups have a much narrower parabola except for the group of “some college.” If the “some college” is grouped into tertiary education along with the “bachelor degree or more” group, the pattern becomes more manifested. The more educated group of women have more responsive parity distribution to a change in the fertility level, which is also consistent across three measures. That is, a change in parity distribution has been more active among the most educated for the cohorts observed in this study.

Discussion and Conclusion

Reproductive concentration is derived from a simple measure of how many women have half of the children in a given population. Childbearing and child-rearing require substantive resources and efforts. Given the frequent negative association between women’s fertility and social status, disadvantaged women are more likely to face the heavy burden of rearing many children in addition to their already inferior social status. Changes in parity distribution also reflects shifts in household size and structure, thus offering an idea of what to expect in diverse areas in the near future from preferences in consumer goods ranging from sizes of dinner tables to social security reform, including elderly support (Lutz, 1989). However, research on fertility concentration remains limited and findings are inconsistent across studies. The ambiguity of concentration measures also makes it difficult to identify the relationship between the level of fertility and education.

Building on prior studies, this study applied three measures of fertility concentration—the CR, Kolm index, and the VMR—to the case of Korea, which has experienced rapid decline in fertility in the late twentieth century. Despite variation across measures, fertility concentration in Korea has gradually declined until the 1960 cohort, which reached replacement fertility but then began to rebound among recent cohorts of women. The reversal of the trend is most pronounced in the relative index of inequality, the CR, whereas it remains small or negligible in the absolute level of inequality (Kolm index) and the index of dispersion (VMR). Probably, the shift from a descending trend into an ascending trend is attributable to the recent rise in childlessness among women of younger cohorts especially for educated women.

This study makes several contributions to the literature. First, I find that the standardized dispersion, the VMR, is most appropriate for the analysis of the developing countries that have experienced a rapid decline in fertility if one must choose among the three measures. The VMR is not only stable, but it also accurately reflects change in childlessness among latest cohorts. The CR is too sensitive to change in parity distribution while the Kolm index is less responsive. In addition, both measures are underestimated when different higher order births are grouped together into the highest category especially in places with high fertility.

Second, this study also finds that fertility concentration has a non-linear relationship with the level of fertility. As in many European countries, the downward trend in fertility concentration reversed itself around sub-replacement fertility in Korea. The rebound of concentration makes the trend a quadratic *J*-shaped curve, which disputes a linear relationship in the earlier literature. Given that the highest cohort fertility is below 6 in this study, the *J*-shaped curve between level and concentration of fertility might be overall in line with the slanted *S*-shaped curve, claimed in a prior study (Barakat, 2014). Unlike the *J*-shaped curve in this study, the *S*-shaped curve includes another negative parabola around the pre-transitional level of fertility. That part could be truncated in this study due to the absence of high fertility above 6.0, but it needs further investigations.

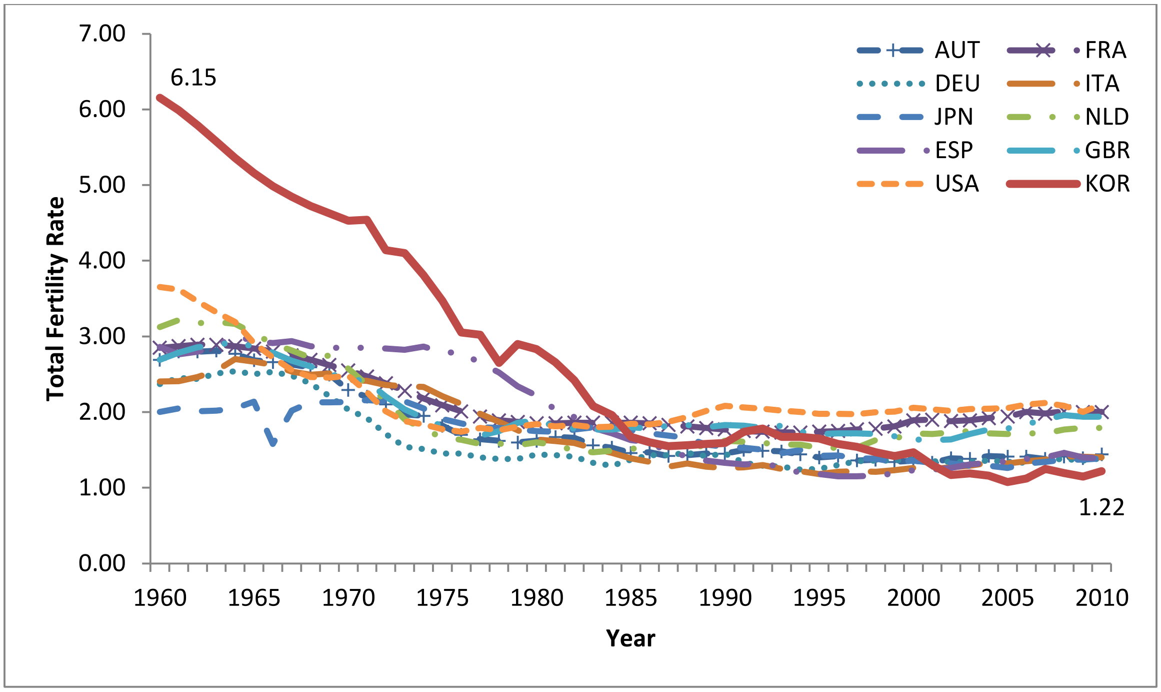
Lastly, the three measures of fertility concentration are overall negatively associated with levels of education. In general, less educated groups show greater fertility concentration, which contradicts some earlier works in the literature. However, that pattern has changed among recent cohorts born in the 1960s and later. On the one hand, fertility concentration rose for the least educated greater than for others, which might be due to the combination between marriage decline and the rise in childlessness for this group. However, as the share of the group is negligible (less than1%), its impact to overall population is also negligible. On the other hand, the fertility concentration of two groups with tertiary education—"some college" and "bachelor and more"—is higher than that of the "upper secondary" group among the latest cohort. The relative rise in fertility concentration for the educated groups is consistent with prior research (Spielauer, 2005), although the increase is not as great as in the earlier study. Since the majority of women (more than 95%) complete secondary or tertiary education in Korea, this change has important implications. The change evidences that parity distribution becomes increasingly diversified among the most educated—although more women remain childless, the progression to higher parity is more prominent in this group (Yoo 2014).

Distributional change in childbearing may be more important than we expect. As discussed in Lutz (1989), change in parity distribution can be related to diverse issues such as children's socialization, parents' consumption propensity, the housing market, the education market, and kinship support. However, above all that, difference in parity distribution can have demographic leverage for reproducing future generations. For example, suppose two countries have the exactly same cohort fertility around 1.8 but with different parity distributions. One country has more diversity in parity distribution, which consists of a high share of childless women and a wide range of women with children. In contrast, another country has a narrower distribution, which has few childless women, the great majority of whom have one or two children. A minor difference in parity distribution could make a big difference in fertility over generations even for moderate correlations between mothers' and daughters' fertility (Lutz, 1989; Lutz, Skirbekk, & Testa, 2006). Thanks to a relatively large share of childless women, the children in the former country are more likely to grow up with many siblings in their childhood while those in the latter country have no siblings or perhaps one. The gap between the two countries will continue to grow over generations as far as the correlation of fertility between mothers and daughters is consistent, regardless of its strength. In that sense, having more diversity in parity distribution can be more advantageous for countries that want to avoid extremely low fertility. On the contrary, having narrower parity distribution can be helpful for preparing coherent and uniform policies such as support for childcare and the elderly. It may also be possible for child-rearing and parenting to be shared in a more effective way that could ultimately contribute to improvement in well-being for both parents and children.

The former case is close to Western countries such as Sweden and the U.S., while the latter is closer to the situation in East Asian countries, especially South Korea. The parity distribution of Korea, where more than half of the women have two children and there are a negligible number of childless women, is likely a product of structural and contextual effects that includes culture, economic conditions, and public policies if randomness is taken for granted. Family-planning programs and nation-wide campaigns have established the desirability of small family size from the early stages of development. Building a normative family size was a fine strategy to achieve fertility decline in the past, but it also resulted in a monotonic parity distribution, which might obstruct a rise in fertility. It would be interesting to investigate whether the difference in parity distribution brings about a different demographic outcome in the next generation.

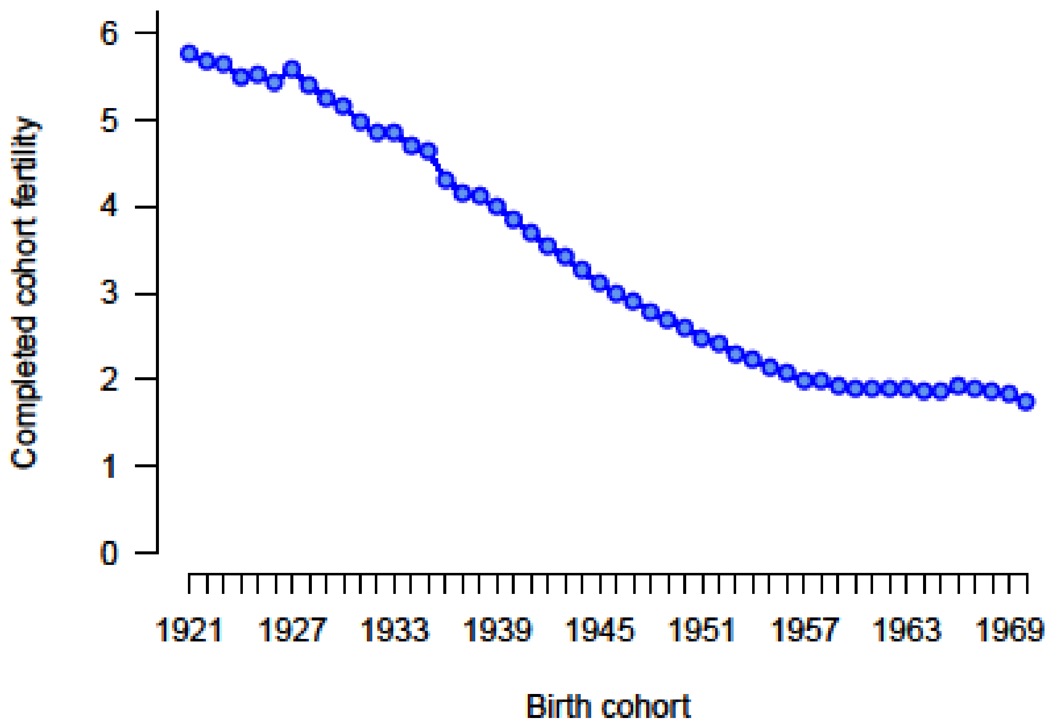
Fertility concentration has declined in Korea to the point where cohorts have reached sub-replacement fertility. However, fertility concentration began to rebound among birth cohorts born in the 1960s and later, probably due to the rise in childless women. The growing amount of childlessness and a highly selective progression to high parity in the country are expected to push the fertility concentration further up. However, the overall level of concentration is still much lower than in European countries. In settings such as East Asia where low fertility has sustained in the past decades, interest in parity distribution could increase among experts and policy makers due to policy implications. As most Social Security policies are centered on families in East Asia, serious inequality issues could arise with regard to childcare and elderly support if the share of childlessness increases as much as in European countries. Research on the causes and consequences of different parity distribution will expand our knowledge of demographic changes and contribute to establishing a theoretical basis for further research.

Figure 4-1. Total Fertility Rates of Korea and Developed Countries, 1960–2010.



Sources: Korean National Statistics Office (2012); Eurostat (2012).

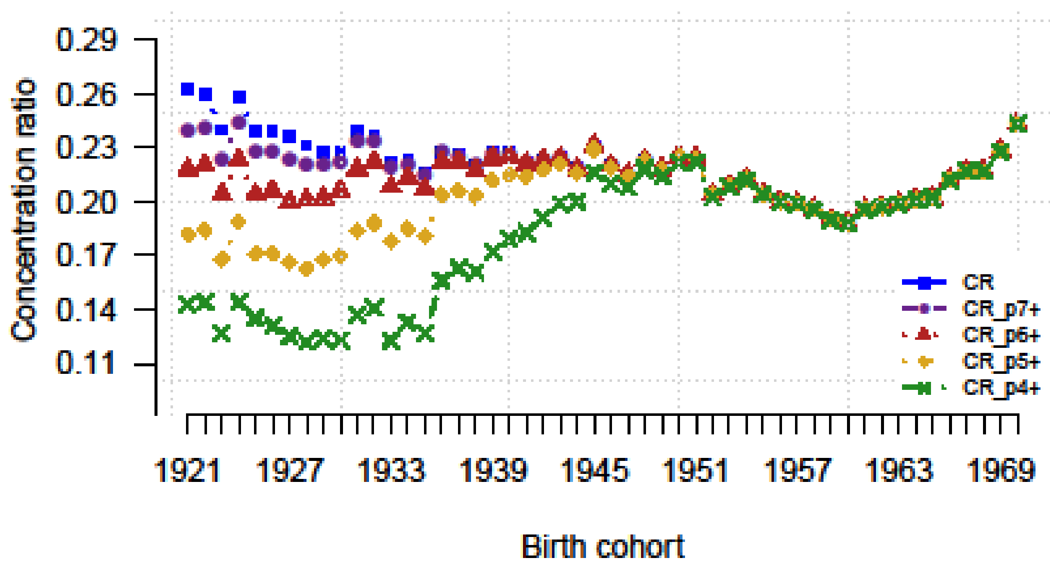
Figure 4-2. Completed Cohort Fertility for Women in Cohorts Born between 1921 and 1970.



Sources: The author's own calculation.

Figure 4-3. Underestimation of the Concentration Ratio and the Kolm Index with Various Highest Parity Categories.

a. concentration ratio



b. Kolm index

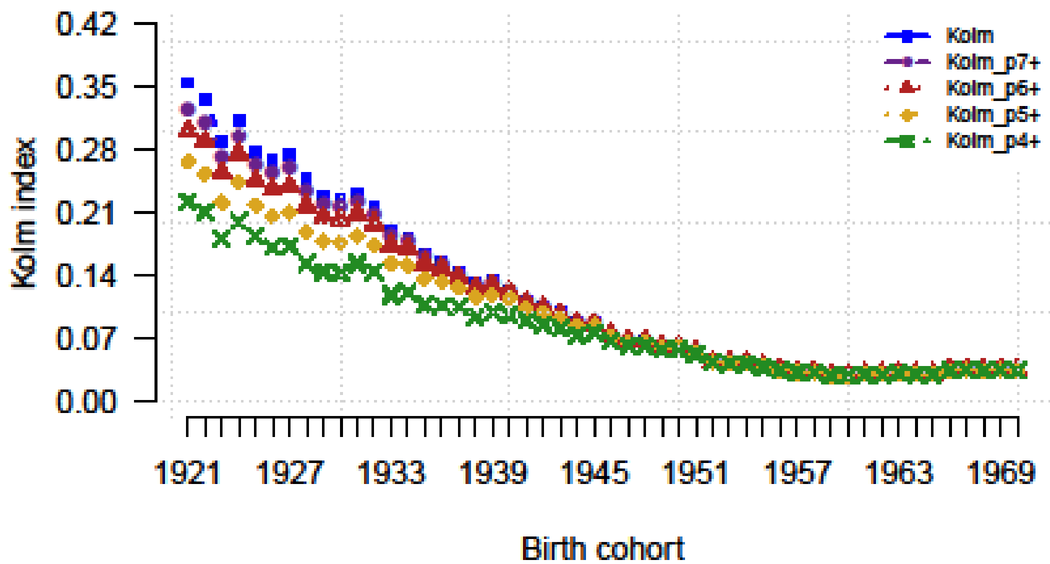


Figure 4-4. Trends in Three Measures of Fertility Concentration over Birth Cohorts.

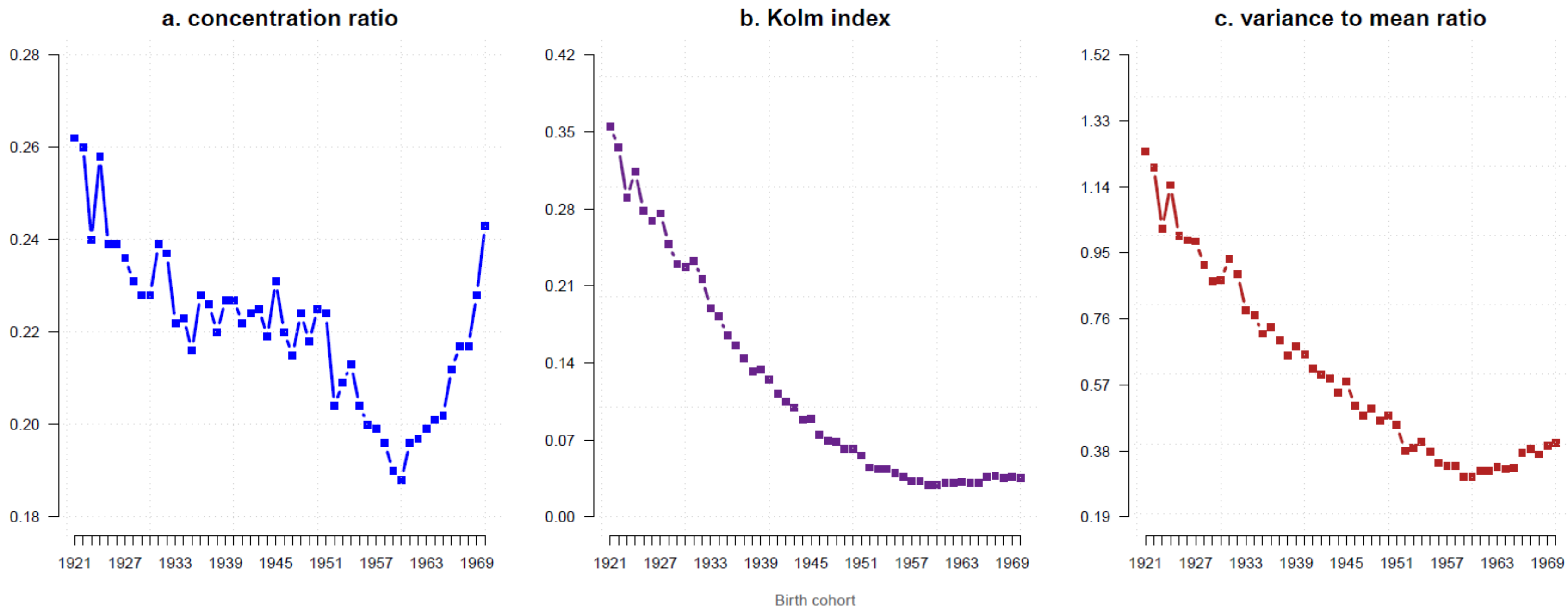


Figure 4-5. Trends in Three Measures of Fertility Concentration over Level of Completed Cohort Fertility

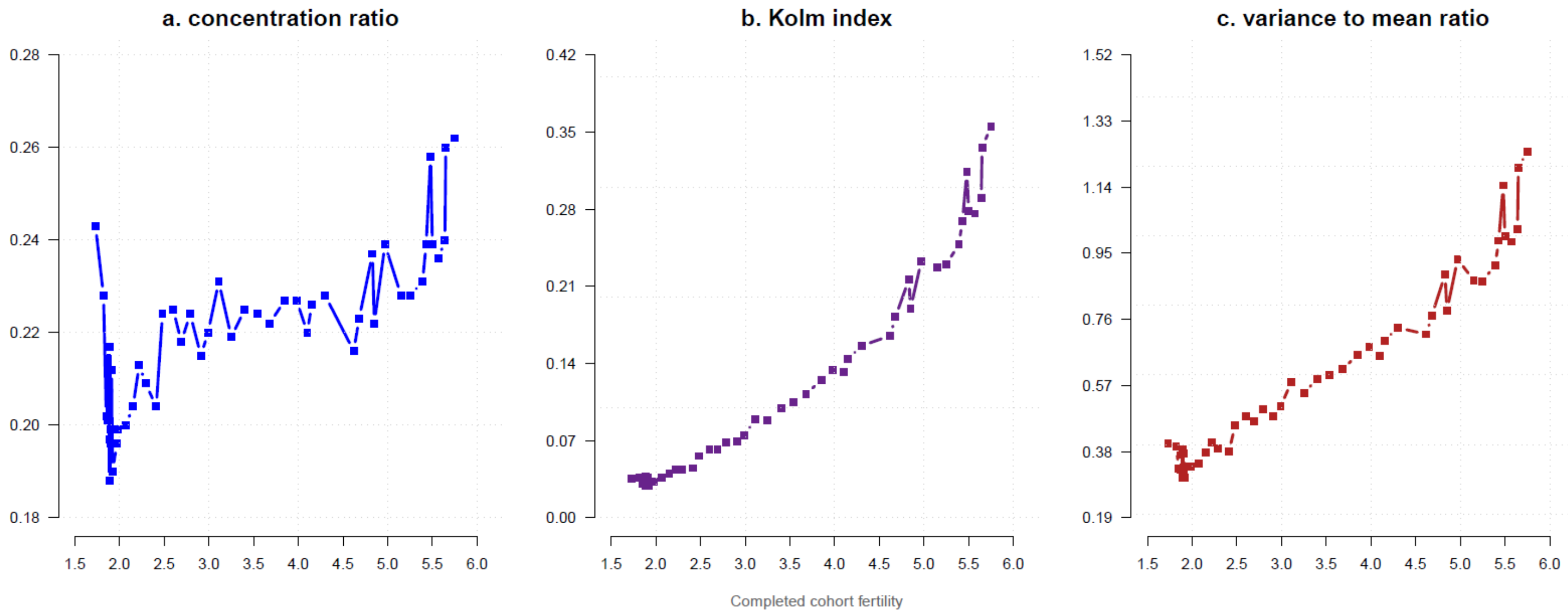
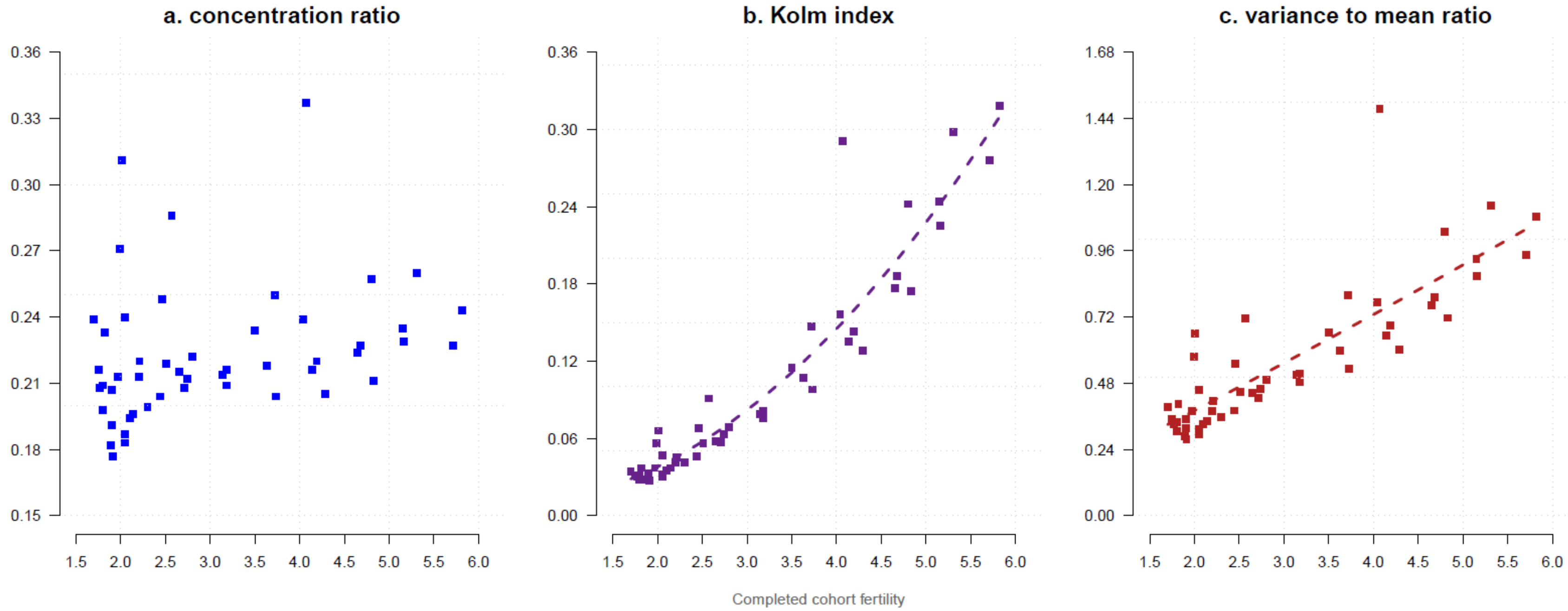
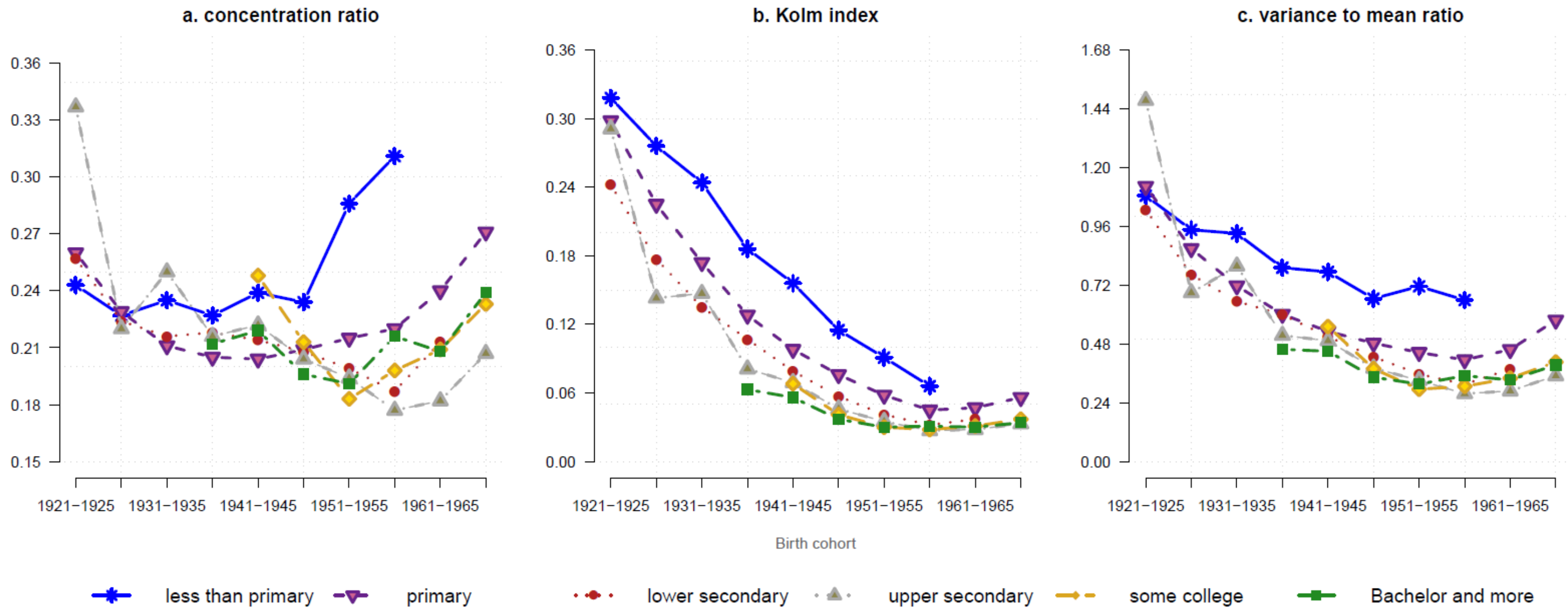


Figure 4-6. Level and Concentration of Fertility among Disaggregated Educational Groups.



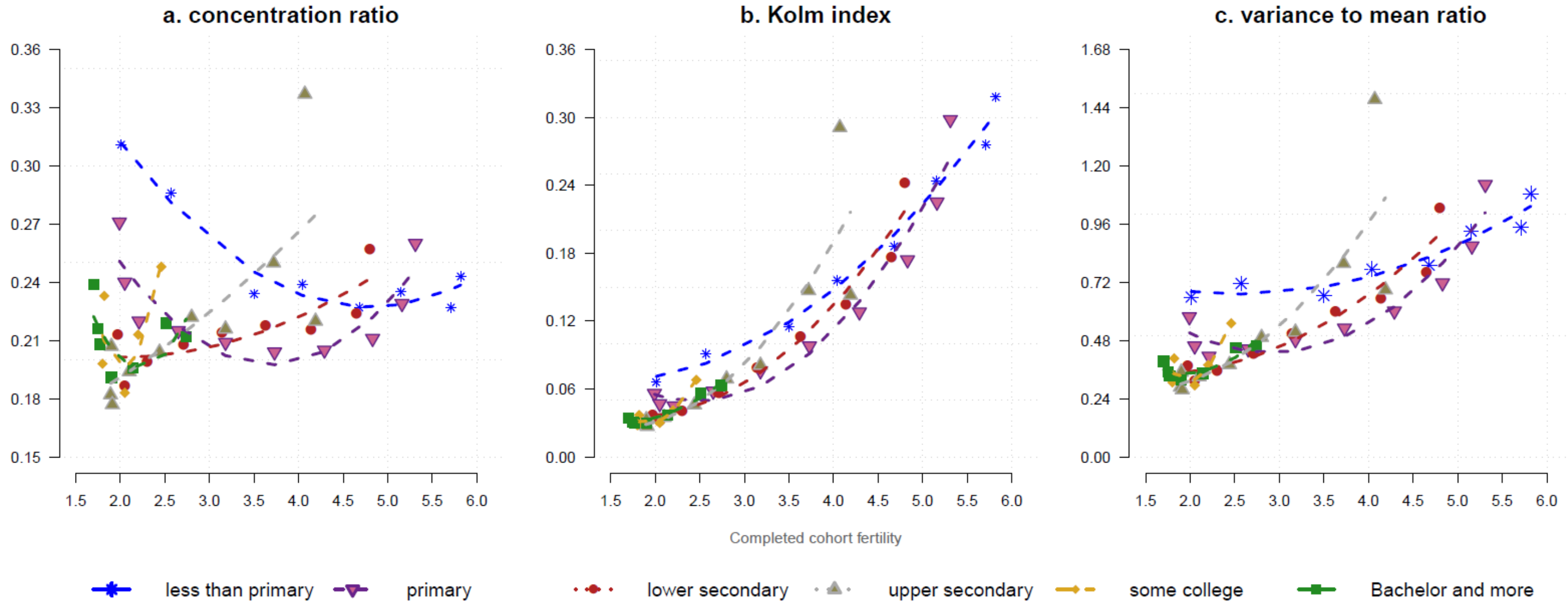
Note: Educational groups that represent less than 1% of the samples for the corresponding cohort, were omitted in this figure.

Figure 4-7. Trends in Three Measures of Fertility Concentration by Level of Education.



Note: Educational groups that represent less than 1% of the samples for the corresponding cohort, were omitted in this figure.

Figure 4-8. Level and Concentration of Fertility by Level of Education.



Note: Educational groups that represent less than 1% of the samples for the corresponding cohort, were omitted in this figure.

CHAPTER 5

CONCLUSION

In this dissertation, I address three different themes—fertility differentials, marriage delay, and fertility concentration—that expand our knowledge of changes in fertility and family formation. The first theme explores the dynamic association between women's educational attainment and fertility particularly in settings where the fertility decline process has been intense and compressed. The second theme focuses on the marriage *postponement* and *recuperation* process and how it has changed in settings that have a universal marriage tradition. The third and final theme focuses on distributional change in childbearing and how it relates to fertility level and education.

The three papers addressing the aforementioned themes, are among the first few investigations that discuss the long-term process of demographic transitions in East Asia from pre- and early-transitional stages to the post-transitional stages—the entry stage of the second demographic transition. Despite extensive literature, empirical research that embraces multiple generations is rare particularly among countries outside Europe. As a result, each of these papers provides an opportunity to understand how demographic behaviors have differentially changed across levels of education over the transition from high to very low fertility. The Korean case illustrates how demographic changes gradually filter through different groups in a society and eventually contribute to upending old traditions such as high fertility and universal marriage in developing countries.

The first paper examines the pattern of educational differentials in cohort fertility. Fertility differentials by level of education have gradually declined and eventually converged around the cohorts that reached replacement fertility. Falling fertility has shifted from the most educated to the least educated in a very compressed period. The expansion of higher education has played an important role only for the birth cohorts born after the 1960s. Consequently, the role of education in fertility decline was more pronounced in the diffusion of innovative ideas and behaviors rather than directly impacting fertility.

The second paper describes two substantial transitions in marriage timing in the context of a long-lasting marriage delay. Political turbulence including World War II and the Korean War triggered the first shifts in women's marriage age for the cohorts born in and after the 1930s, from the late teens to the early 20s. The following cohorts successfully settled the changed marriage schedule without returning to the traditional pattern. Another shift appeared among women born in and after the 1960s. The marriage delay further increased while the recuperation of delayed marriage began to protract and diminish for the more recent cohorts. Unlike in previous decades, in which nearly all delayed marriages were made up later, more marriage delays appear to end in non-marriage and such a trend is more pronounced among the most educated women. Given trends in marriage P&R process, it is projected that the collapse of universal marriage is not far away in Korea.

Regarding fertility concentration, the study finds that the association between concentration and level of fertility shows a *J*-shaped relationship with converging vertexes around sub-replacement fertility. The fertility concentration has begun to rebound around sub-replacement fertility probably due to the increasing share of childless women. The steeper slope for the educated group reflects more varied childbearing behaviors among advantaged groups. Unlike in European countries, parity distributions are centered on the mean and neighboring parity while childless women remain marginal. The lack of variation in parity distribution reflects the fact that childbearing behaviors in Korea are strongly influenced by cultural and structural factors such as social norms and economic constraints related to parenthood. Apart from this, the paper also finds that both relative and absolute indexes of inequality require special attention when applied to populations with high fertility due to the possibility of underestimation.

The findings of the dissertation illustrate how fertility and marriage patterns have changed over generations ranging from a tumultuous period to an advanced economic period. In the postwar period that led to desolation and destitution, all possible means to improve the standard of living—such as the delay of marriage and contraceptive use that might have been against traditional norms—were easily and widely accepted by the public. During the period of modernization and industrialization, the conjugal family with two children—later changed to one child—was encouraged as an ideal family by authorities. Fertility and family formation converged as the social norm until the cohorts born in and after the 1960s. Often called the "democratization generation," this group benefitted from the expansion of higher education in the 1980s and actively participated in a movement for democracy against dictatorships. This generation was also distinguished by their differences in childbearing and marriage. Marriage and childbearing behaviors began to diversify and variation by social groups also increased. The economic uncertainty caused by the Asian financial crisis in the late 1990s further accelerated demographic changes such as low fertility and marriage delay.

Three papers of this dissertation together coincide in demographic trends, “convergence towards diversity.” These papers commonly show that childbearing and marriage behaviors tend to have standardized for the first demographic transition while these are being diversified for the ongoing second demographic transition. Within the cohorts analyzed in this dissertation, differences in number of children have declined and eventually almost disappeared after the cohorts born in the 1960s. Women’s age at first marriage has also continuously extended, but more women began to end with lifetime singlehood from the cohorts that reached sub-replacement fertility. As an outcome, a share of childless women started increasing among recent cohorts.

East Asian countries may share these demographic trends to varying degrees. Japan, Taiwan, and South Korea share rapid economic growth, extended education, and population policies. China is also in line with these countries’ experiences. Rapid urbanization and industrialization as well as strong family planning programs might have resulted in standardized behaviors with regard to childbearing and marriage. Extended education and improvements in female status may create diversity in these behaviors. Economic uncertainty and different responses by social status can also contribute to differences in demographic behaviors.

Most societies that have entered the second demographic transition may share these demographic trends, convergence towards diversity. In general, demographic transition is closely related to economic growth and modernization. In a process which diverse parts in a society are modernized, children’s socialization and education also tend to be standardized by public schooling system. Then, childbearing and marriage behaviors are more likely to change into a more standardized form. This change might be gradually reversed as extended education and increased accounts of individualism transform ways of childbearing and union formation. Childbearing is separated from marriage while marriage declines in contemporary advanced societies. As a result, childbearing and union formation are increasingly diversified. Structural effects, policy effects, and regional circumstances may accelerate or delay these trends. Otherwise, different contexts may lead to different demographic trajectories. The topics on these demographic trends across regions and countries will remain a promising field of research.

Men's childbearing and marriage may be different from women's. Men's education is positively associated with fertility in Western countries (e.g., Lappegård & Rønsen, 2013; Nisén et al., 2014). Given men's breadwinning role and hypergamy tradition in East Asia, educated men are expected to have higher number of children. Due to lack of data, however, little is known about educational differences among men in this region and thus, this topic remains to be proven by future research. Timing of marriage and the extent of marriage delay can also differ by gender. In the context of hypergamy, where women marry up with men with higher status, the lowest status men and the highest status women have difficulty in finding an appropriate partner. This is evidenced by recent rise in international marriage for the corresponding groups in South Korea (Kim 2010). Accordingly, less educated men are more likely to delay marriage while less likely to recuperate it in later ages. Research on educational differences in men's marriage timing will shed light on different mechanisms of marriage market between men and women.

This dissertation offers important implications for further research and policy efforts. As shown, marriage is increasingly delayed and is expected to further decline for a period of time. Given the strong attachment of childbearing to marriage, cohort fertility will not rebound in the near future unless drastic social changes happen that encourage out-of-wedlock births. Policies that lower the barriers (e.g., youth unemployment and housing) to marriage and accommodate diverse forms of families can alleviate the sustained low fertility and rapid aging of the population. Research on cohabitation and non-marital births will be instrumental for understanding possible trajectories not only in Korea but also in other East Asian countries. Non-marriage could be more pronounced among the most educated women in the near future, but it does not necessarily accompany a rise in cohabitation and out-of-wedlock births for the group. Cohabitation and non-marital births appear first in the most educated women and subsequently spread from the lowest educated to others, similar to what happened in the U.S. where marriage is still preferred for most people. Longitudinal data including contraceptive use, pregnancy history, and partnership history, regardless of sex and marital status, could considerably improve our understanding of how young people respond to diverse societal and economic changes, which would eventually contribute to establishing better policies.

REFERENCES

Abbasi-Shavazi, M. J., Lutz, W., Hosseini-Chavoshi, M., KC, S., & Nilsson, S. (2008). Education and the world's most rapid fertility decline in Iran. Laxenburg, Austria: International Institute for Applied Systems Analysis,.

Alves, J. C. S., & Cavenaghi, S. (2009). *Timing of childbearing in below replacement fertility regimes: how and why Brazil is different*. Paper presented at the XXVI IUSSP International Population Conference, Marrakech, Morocco, Sep 27−Oct 2 2009.

Amaral, E. F. L., & Potter, J. E. (2009). Políticas de población, programas gubernamentales y fecundidad: una comparación entre el Brasil y México. *Notas de Población, 87*, 7-33.

Andersson, G., Rønsen, M., Knudsen, L. B., Lappegård, T., Neyer, G., Skrede, K., . . . Vikat, A. (2009). Cohort fertility patterns in the Nordic countries. *Demographic Research, 20*(14), 313-352.

Atoh, M., Kandiah, V., & Ivanov, S. (2004). The second demographic transition in Asia? Comparative analysis of the low fertility situation in East and South-East Asian countries. *The Japanese Journal of Population, 2*(1), 42-75.

Axinn, W. G., & Barber, J. S. (2001). Mass education and fertility transition. *American Sociological Review, 66*(4), 481-505.

Barakat, B. (2014). Revisiting the history of fertility concentration and its measurement: Vienna Institute of Demography Working Papers.

Becker, G. S. (1981). *A Treatise on the Family*: Harvard university press.

Billari, F. C., & Liefbroer, A. C. (2010). Towards a new pattern of transition to adulthood? *Advances in Life Course Research, 15*(2–3), 59-75.

Billari, F. C., & Wilson, C. (2001). Convergence towards diversity? Cohort dynamics in the transition to adulthood in contemporary Western Europe. *Max Planck Institute for Demographic Research, Working Paper WP2001-039*.

Blossfeld, H. P. (1995). Changes in the process of family formation and women's growing economic independence: A comparison of nine countries *The new role of women: Family formation in modern societies* (pp. 3-32).

Bongaarts, J. (2003). Completing the fertility transition in the developing world: The role of educational differences and fertility preferences. *Population Studies, 57*(3), 321-335.

Bongaarts, J. (2010). The causes of educational differences in fertility in Sub-Saharan Africa. *Vienna Yearbook of Population Research, 8*, 31-50.

Bongaarts, J., & Feeney, G. (1998). On the quantum and tempo of fertility. *Population and Development Review*, 271-291.

Bras, H. (2014). Structural and diffusion effects in the Dutch fertility transition, 1870-1940. *Demographic Research, 30*(5), 151-186.

Caldwell, J. C. (1980). Mass education as a determinant of the timing of fertility decline. *Population and Development Review, 6*(2), 225-255.

Caldwell, J. C. (1982). *Theory of fertility decline*: Academic Press New York.

Carlsson, G. (1966). The Decline of Fertility: Innovation or Adjustment Process. *Population Studies, 20*(2), 149-174.

Casterline, J. B. (2001). Diffusion processes and fertility transition: Introduction. *Diffusion Processes and Fertility Transition*, 1-38.

Castro Martín, T. (1995). Women's education and fertility: results from 26 Demographic and Health Surveys. *Studies in Family Planning*, 187-202.

Chang, D. H. (1979). The Korean Family. In M. S. Das & P. D. Bardis (Eds.), *The family in Asia* (pp. 277-319). London: Allen and Unwin.

Chevan, A., & Sutherland, M. (2009). Revisiting das gupta: Refinement and extension of standardization and decomposition. *Demography, 46*(3), 429-449.

Choe, M. K., & Park, K. A. (2006). Fertility decline in South Korea: Forty years of policy-behavior dialogue. *Korea Journal of Population Studies, 29*(2), 1-26.

Choe, M. K., & Retherford, R. D. (2009). The Contribution of Education to South Korea's Fertility Decline to Below 'Lowest-Low'Level. *Asian Population Studies, 5*(3), 267-288.

Chung, W., & Das Gupta, M. (2007). The decline of son preference in South Korea: The roles of development and public policy. *Population and Development Review, 33*(4), 757-783.

Cleland, J. (2001). Potatoes and pills: An overview of innovation-diffusion contributions to explanations of fertility decline. *Diffusion processes and fertility transition: Selected perspectives*, 39-65.

Cleland, J. (2002). Education and future fertility trends, with special reference to mid-transitional countries. *Population Bulletin of the United Nations, Special Issue: Completing the Fertility Transition*(48/49), 183-194.

Coale, A. J. (1973). The demographic transition reconsidered *International Population Conference, Liège, 1973* (Vol. 1). Liège: International Union for the Scientific Study of Population.

Coale, A. J., & McNeil, D. R. (1972). The Distribution by Age of the Frequency of First Marriage in a Female Cohort. *Journal of the American Statistical Association, 67*(340), 743-749.

Cochrane, S. H. (1979). *Fertility and education: What do we really know?* Baltimore and London: The Johns Hopkins University Press for the World Bank.

Das Gupta, P. (1993). *Standardization and decomposition of rates: A user's manual*: US Department of Commerce, Economics and Statistics Administration, Bureau of the Census.

Davis, K. (1945). The World Demographic Transition. *The annals of the American academy of political and social science, 237*(1), 1-11.

DeLeone, F. Y., Lichter, D. T., & Strawderman, R. L. (2009). Decomposing trends in nonmarital fertility among Latinas. *Perspectives on Sexual and Reproductive Health, 41*(3), 166-172.

Dorius, S. F. (2008). Global Demographic Convergence? A Reconsideration of Changing Intercountry Inequality in Fertility. *Population and Development Review, 34*(3), 519-537.

Feeney, G. (1991). Fertility decline in taiwan: A study using parity progression ratios. *Demography, 28*(3), 467-479.

Firebaugh, G. (1999). Empirics of World Income Inequality. *American Journal of Sociology, 104*(6), 1597-1630.

Frejka, T. (2011). The Role of Contemporary Childbearing Postponement and Recuperation in Shaping Period Fertility Trends. *Comparative Population Studies-Zeitschrift für Bevölkerungswissenschaft, 36*(4), 927-958.

Frejka, T., & Calot, G. (2001). Cohort Reproductive Patterns in Low-Fertility Countries. *Population and Development Review, 27*(1), 103-132.

Frejka, T., Jones, G. W., & Sardon, J. P. (2010). East Asian childbearing patterns and policy developments. *Population and Development Review, 36*(3), 579-606.

Frejka, T., & Sardon, J.-P. (2007). Cohort birth order, parity progression ratio and parity distribution trends in developed countries. *Demographic Research, 16*(11), 315-374.

Frejka, T., & Sardon, J. P. (2004). *Childbearing Trends and Prospects in Low-Fertility countries: A cohort analysis* (Vol. 13): Springer.

Giroux, S. C., Eloundou-Enyegue, P. M., & Lichter, D. T. (2008). Reproductive Inequality in Sub-Saharan Africa: Differentials versus Concentration. *Studies in Family Planning, 39*(3), 187-198.

Goldstein, J. R., & Kenney, C. T. (2001). Marriage delayed or marriage forgone? New cohort forecasts of first marriage for US women. *American Sociological Review*, 506-519.

Gong, S.-K., Jo, A., Kim, S.-K., & Son, S.-H. (1992). *Family Formation and Fertility Behaviors in Korea*. Seoul: Korea Institute for Health and Social Affairs.

Hajnal, J. (1965). European marriage patterns in perspective. In D. V. Glass & D. E. C. Eversley (Eds.), *Population in History: Essays in Historical Demography* (pp. 101-143). London: Arnold.

Hayford, S. R. (2005). Stable aggregate fertility in a time of family change: A decomposition of trends in American fertility, 1970–1999. *Biodemography and Social Biology, 52*(1-2), 1-17.

Hong, S.-b., & Watson, W. B. (1972). The Role of Induced Abortion in Fertility Control in Korea. *Australian and New Zealand Journal of Obstetrics and Gynaecology, 13*, 115-120.

Hout, M., Greeley, A., & Wilde, M. J. (2001). The Demographic Imperative in Religious Change in the United States. *American Journal of Sociology, 107*(2), 468-500.

James, K. S., Skirbekk, V., & Van Bavel, J. (2012). Education and the Global Fertility Transition - Foreword. *Vienna Yearbook of Population Research, 10*, 1-8.

Jeffery, R., & Basu, A. M. (1996). *Girls' Schooling, Women's Autonomy and Fertility Change in South Asia*. New Delhi: Sage.

Jejeebhoy, S. J. (1995). *Women's Education, Autonomy, and Reproductive Behaviour: Experience from Developing Countries*. Oxford: Clarendon Press.

Jones, G. W. (2007). Delayed Marriage and Very Low Fertility in Pacific Asia. *Population and Development Review, 33*(3), 453-478.

Jones, G. W., & Gubhaju, B. (2009). Factors influencing changes in mean age at first marriage and proportions never marrying in the low-fertility countries of East and Southeast Asia. *Asian Population Studies, 5*(3), 237-265.

Jun, K.-H. (2005). The transition to sub-replacement fertility in South Korea: Implications and prospects for population policy. *The Japanese Journal of Population, 3*(1), 26-57.

Kaufmann, E., Goujon, A., & Skirbekk, V. (2012). American political affiliation, 2003–43: A cohort component projection. *Population Studies, 66*(1), 53-67.

Kim, D.-S. (2005). Theoretical explanations of rapid fertility decline in Korea. *The Japanese Journal of Population, 3*(1), 2-25.

Kim, D.-S. (2007). *The 'IMF' Economic Crisis and Changes in Korean Fertility*. Seoul: Jipmoondang.

Kim, D.-S. (2010). The Rise of Cross-border Marriage and Divorce in Contemporary Korea. In W.-S. Yang & M. C.-W. Lu (Eds.), *Asian cross-border marriage migration: demographic patterns and social issues* (pp. 127-153). Amsterdam: Amsterdam University Press.

Kim, G.-J. (2002). Education policies and reform in South Korea. In T. W. B. African Region (Ed.), *Secondary education in Africa: Strategies for renewal* (pp. 29-40). Washington, DC: The World Bank.

Kohler, H. P., Billari, F. C., & Ortega, J. A. (2002). The emergence of lowest-low fertility in Europe during the 1990s. *Population and Development Review, 28*(4), 641-680.

Kravdal, Ø., & Rindfuss, R. R. (2008). Changing relationships between education and fertility: A study of women and men born 1940 to 1964. *American Sociological Review, 73*(5), 854-873.

Kwon, T.-H. (2007). Trends and Implications of Delayed and Non-Marriage in Korea. *Asian Population Studies, 3*(3), 223-241.

Kwon, T. H. (2001). The national family planning program and fertility transition in South Korea. *Population Policies and Programs in East Asia*, 39-64.

Kye, B. (2012). Cohort Effects or Period Effects? Fertility Decline in South Korea in the Twentieth Century. *Population Research and Policy Review*, 1-29.

Lam, D., & Duryea, S. (1999). Effects of schooling on fertility, labor supply, and investments in children, with evidence from Brazil. *Journal of Human Resources, 34*(1), 160-192.

Lapierre-Adamcyk, E., & Burch, T. K. (1974). Trends and Differentials in Age at Marriage in Korea. *Studies in Family Planning, 5*(8), 255-260.

Larsen, U., Chung, W., & Das Gupta, M. (1998). Fertility and son preference in Korea. *Population Studies, 52*(3), 317-325.

Lee, B. S., & Farber, S. C. (1984). Fertility adaptation by rural—urban migrants in developing countries: The case of Korea. *Population Studies*, *38*(1), 141-155.

Lee, B. S., & Pol, L. G. (1993). The influence of rural-urban migration on migrants' fertility in Korea, Mexico and Cameroon. *Population Research and Policy Review, 12*(1), 3-26.

Lee, S.-S. (2009). Low fertility and policy responses in Korea. *The Japanese Journal of Population, 7*(1), 57-70.

Lesthaeghe, R. (2001, 21-23 March, 2001). *Postponement and recuperation: Recent fertility trends and forecasts in six Western European countries.(Austria, Belgium, France, Germany, Switzerland and the Netherlands).* Paper presented at the International Perspectives on Low Fertility: Trends, Theories and Policies, Tokyo.

Lesthaeghe, R. (2010). The unfolding story of the Second Demographic Transition. *Population and Development Review, 36*(2), 211-251.

Lesthaeghe, R., & Moors, G. (2000). Recent trends in fertility and household formation in the industrialized world. *Review of Population and Social Policy, 9*(1), 121-170.

Lesthaeghe, R., & van de Kaa, D. J. (1986). Twee demografische transities ('Two demographic transitions?'). In R. Lesthaeghe & D. J. van de Kaa (Eds.), *Bevolking: groei en krimp* (pp. 9-24). Deventer: Van Loghum-Slaterus.

Lichter, D. T., & Wooton, J. (2005). The concentration of reproduction in low-fertility societies: The case of the United States. In A. Booth & A. C. Crouter (Eds.), *The New Population Problem: Why Families in Developed Countries Are Shrinking and What It Means. Mahwah, NJ, London: Lawrence Erlbaum Associates* (pp. 213-224). New York: Lwarence Erlbaum Associates.

Lutz, W. (1989). *Distributional aspects of human fertility: A global comparative study*: Academic Pr.

Lutz, W., & Goujon, A. (2001). The World's Changing Human Capital Stock: Multi-State Population Projections by Educational Attainment. *Population and Development Review, 27*(2), 323-339.

Lutz, W., Skirbekk, V., & Testa, M. R. (2006). The Low-Fertility Trap Hypothesis: Forces that May Lead to Further Postponement and Fewer Births in Europe. *Vienna Yearbook of Population Research, 4*, 167-192.

Mare, R. D. (1997). Differential Fertility, Intergenerational Educational Mobility, and Racial Inequality. *Social Science Research, 26*(3), 263-291.

McDonald, P. (2002). Sustaining Fertility through Public Policy: The Range of Options. *Population (English Edition, 2002-), 57*(3), 417-446.

Montgomery, M. R., & Chung, W. (1999). Social networks and the diffusion of fertility control in the Republic of Korea. In R. Leete (Ed.), *Dynamics of values in fertility change* (pp. 179-209). Oxford, England: Oxford University Press.

Murphy, M. (2009). Where have all the children gone? Women's reports of more childlessness at older ages than when they were younger in a large-scale continuous household survey in Britain. *Population Studies, 63*(2), 115-133.

Musick, K., England, P., Edgington, S., & Kangas, N. (2009). Education differences in intended and unintended fertility. *Social Forces*, *88*(2), 543-572.

Ní Bhrolcháin, M., Beaujouan, É., & Murphy, M. (2011). Sources of error in reported childlessness in a continuous British household survey. *Population Studies, 65*(3), 305-318.

Notestein, F. W. (1953). *Economic problems of population change*: Oxford University Press London.

Ono, H. (2004). Women's Economic Standing, Marriage Timing, and Cross-National Contexts of Gender. *Journal of Marriage and Family, 65*(2), 275-286.

Oppenheimer, V. K. (1988). A theory of marriage timing. *American Journal of Sociology*, 563-591.

Oppenheimer, V. K. (1997). Women's employment and the gain to marriage: The specialization and trading model. *Annual Review of Sociology*, 431-453.

Park, H., Lee, J. K., & Jo, I. (2013). Changing Relationships between Education and Marriage among Korean Women. *Korean Journal of Sociology, 47*(3), 51-76.

Park, H. J., Kincaid, D. L., Chung, K. K., Han, D. S., & Lee, S. B. (1976). The Korean mothers' club program. *Studies in Family Planning, 7*(10), 275-283.

Preston, S. H., Heuveline, P., & Guillot, M. (2001). *Demography: Measuring and Modeling Population Processes*. Oxford, England: Blackwell Publishing.

Raymo, J. M. (2003). Educational attainment and the transition to first marriage among Japanese women. *Demography, 40*(1), 83-103.

Romo, V. C. (2003). *Decomposition Methods in Demography*. Amsterdam, Netherlands: Rozenberg Publishers.

Ryder, N. B. (1965). The cohort as a concept in the study of social change. *American Sociological Review*, 843-861.

Lappegård, T., & Rønsen, M. (2013). Socioeconomic Differences in Multipartner Fertility Among Norwegian Men. *Demography, 50*(3), 1135-1153.

Nisén, J., Martikainen, P., Silventoinen, K., & Myrskylä, M. (2014). Age-specific fertility by educational level in the Finnish male cohort born 1940–1950. *Demographic Research, 31*(5), 119-136.

Shkolnikov, V. M., Andreev, E. M., Houle, R., & Vaupel, J. W. (2007). The concentration of reproduction in cohorts of women in Europe and the United States. *Population and Development Review, 33*(1), 67-100.

Skirbekk, V. (2008). Fertility trends by social status. *Demographic Research, 18*(5), 145-180.

Smith, H. L., Morgan, S. P., & Koropeckyj-Cox, T. (1996). A decomposition of trends in the nonmarital fertility ratios of blacks and whites in the United States, 1960-1992. *Demography, 33*(2), 141-151.

Sobotka, T. (2008). Overview Chapter 6: The diverse faces of the Second Demographic Transition in Europe. *Demographic Research, S7*(8), 171-224.

Sobotka, T., & Toulemon, L. (2008). Overview Chapter 4: Changing family and partnership behaviour: Common trends and persistent diversity across Europe. *Demographic Research, S7*(6), 85-138.

Sobotka, T., Zeman, K., Lesthaeghe, R., & Frejka, T. (2011). Postponement and recuperation in cohort fertility: New analytical and projection methods and their application. *European Demographic Research Papers, 2*.

Sobotka, T., Zeman, K., Lesthaeghe, R., Frejka, T., & Neels, K. (2012). Postponement and Recuperation in Cohort Fertility: Austria, Germany and Switzerland in a European Context. *Comparative Population Studies, 36*(2-3), 417-452.

Spielauer, M. (2005). Concentration of Reproduction in Austria: General Trends and Differentials by Educational Attainment and Urban-Rural Setting. *Vienna Yearbook of Population Research, 3*, 171-195.

Statistics Korea. (2010). 2010 Women's lives through statistics. Daejeon: Statistics Korea.

Statistics Korea. (2015). Korean Statistical Information Service (KOSIS). from Statistics Korea http://kosis.kr/

Suzuki, T. (2005). Why is fertility in Korea lower than in Japan? *Journal of Population Problems, 61*(2), 23-39.

The World Bank. (2013). World Development Indicators. World DataBank Retrieved Oct 28, 2013 http://databank.worldbank.org/

Vaupel, J. W., & Goodwin, D. G. (1987). The concentration of reproduction among US women, 1917-80. *Population and Development Review*, 723-730.

Woo, H. (2012). BIrth cohort and educational differences in the marital and fertility life course in South Korea. *Korea Journal of Population Studies, 35*(1), 151-179.

Yoo, S. H. (2014). Educational differentials in cohort fertility during the fertility transition in South Korea. *Demographic Research, 30*(53), 1463-1494.

Appendix 2-A. Median Age at First Marriage for Women Born between 1926 and 1980, South Korea

Cohort	Median age	Cohort	Median age	Cohort	Median age	Cohort	Median age
c1926	18	c1940	22	c1954	23	c1968	25
c1927	18	c1941	22	c1955	23	c1969	25
c1928	18	c1942	23	c1956	23	c1970	25
c1929	18	c1943	23	c1957	23	c1971	26
c1930	19	c1944	23	c1958	23	c1972	26
c1931	19	c1945	23	c1959	23	c1973	26
c1932	20	c1946	23	c1960	24	c1974	27
c1933	20	c1947	24	c1961	24	c1975	27
c1934	20	c1948	24	c1962	24	c1976	27
c1935	20	c1949	24	c1963	24	c1977	27
c1936	21	c1950	24	c1964	24	c1978	28
c1937	21	c1951	23	c1965	25	c1979	29
c1938	22	c1952	23	c1966	25	c1980	29
c1939	22	c1953	23	c1967	25		

Note: Author's calculations with a life-table method, based on women's age at first marriage from the Korean census sample data of 1980, 1995, 2005, and 2010; Extra birth cohorts of women born between1971 and1980 were added to provide recent trends in the timing of marriage.

Appendix 3-A. Marriage *P&R* Process by Education between the 1916–1920 Cohort and the 1956–1960 Cohort: Base Model

	Postponement (P)	Age at the trough	Recuperation (R) at age				Recuperation Index (RI = R/P)			
			30	35	40	45	30	35	40	45
Incomplete primary										
c1916-1920	0.000		0.000	0.000	0.000	0.000				
c1921-1925	-0.049	18	0.048	0.049	0.050	0.050	0.980	0.994	1.017	1.026
c1926-1930	-0.058	21	0.055	0.056	0.059	0.058	0.944	0.975	1.011	1.005
c1931-1935	-0.256	19	0.252	0.255	0.255	0.255	0.984	0.997	0.999	0.998
c1936-1940	-0.397	19	0.391	0.394	0.396	0.394	0.984	0.992	0.997	0.993
c1941-1945	-0.463	20	0.447	0.456	0.457	0.457	0.964	0.983	0.986	0.986
c1946-1950	-0.469	20	0.429	0.449	0.457	0.457	0.915	0.958	0.974	0.974
c1951-1955	-0.487	20	0.431	0.449	0.454	0.461	0.885	0.921	0.933	0.947
c1956-1960	-0.545	22	0.437	0.461	0.478	0.487	0.802	0.846	0.877	0.894
Primary completion										
c1916-1920	0.000		0.000	0.000	0.000	0.000				
c1921-1925	-0.057	19	0.064	0.060	0.057	0.057	1.117	1.047	0.995	0.995
c1926-1930	-0.066	21	0.070	0.069	0.066	0.067	1.059	1.050	1.000	1.018
c1931-1935	-0.288	20	0.293	0.290	0.288	0.288	1.017	1.008	1.000	1.001

c1936-1940	-0.432	20	0.432	0.433	0.432	0.432	0.998	1.003	0.998	1.000
c1941-1945	-0.514	20	0.512	0.514	0.513	0.514	0.997	1.001	0.998	1.000
c1946-1950	-0.518	21	0.503	0.511	0.512	0.515	0.970	0.985	0.988	0.994
c1951-1955	-0.502	21	0.474	0.489	0.491	0.495	0.945	0.975	0.979	0.986
c1956-1960	-0.514	22	0.470	0.490	0.497	0.502	0.914	0.954	0.968	0.977
Incomplete secondary										
c1916-1920	0.000		0.000	0.000	0.000	0.000				
c1921-1925	-0.027	27	0.004	0.023	0.023	0.023	0.145	0.829	0.829	0.829
c1926-1930	-0.034	27	0.019	0.027	0.034	0.034	0.556	0.810	1.000	1.000
c1931-1935	-0.242	20	0.219	0.234	0.239	0.241	0.902	0.965	0.986	0.993
c1936-1940	-0.355	21	0.323	0.346	0.351	0.352	0.911	0.975	0.989	0.992
c1941-1945	-0.455	22	0.417	0.443	0.448	0.450	0.915	0.973	0.984	0.989
c1946-1950	-0.454	21	0.408	0.436	0.442	0.445	0.899	0.961	0.975	0.981
c1951-1955	-0.422	21	0.370	0.398	0.406	0.411	0.877	0.943	0.962	0.973
c1956-1960	-0.434	22	0.370	0.404	0.415	0.421	0.852	0.930	0.957	0.971
Secondary completion or more										
c1916-1920	0.000		0.000	0.000	0.000	0.000				
c1921-1925	-0.044	18	0.048	0.049	0.050	0.050	0.980	0.994	1.017	1.026

c1926-1930	-0.063	18	0.055	0.056	0.059	0.058	0.944	0.975	1.011	1.005
c1931-1935	-0.241	22	0.252	0.255	0.255	0.255	0.984	0.997	0.999	0.998
c1936-1940	-0.384	23	0.391	0.394	0.396	0.394	0.984	0.992	0.997	0.993
c1941-1945	-0.470	23	0.447	0.456	0.457	0.457	0.964	0.983	0.986	0.986
c1946-1950	-0.424	23	0.429	0.449	0.457	0.457	0.915	0.958	0.974	0.974
c1951-1955	-0.408	22	0.431	0.449	0.454	0.461	0.885	0.921	0.933	0.947
c1956-1960	-0.439	22	0.437	0.461	0.478	0.487	0.802	0.846	0.877	0.894

Appendix 3-B. Marriage *P&R* Process by Education between the 1916–1920 Cohort and the 1956–1960 Cohort: Relational Model

	Postponement	Age	Recuperation (R) at age				Recuperation Index (RI = R/P)			
	(P)	at the trough	30	35	40	45	30	35	40	45
Incomplete primary										
c1916-1920	0.000		0.000	0.000	0.000	0.000				
c1921-1925	-0.049	18	0.048	0.049	0.050	0.050	0.980	0.994	1.017	1.026
c1926-1930	-0.030	22	0.027	0.028	0.029	0.029	0.924	0.961	0.994	0.966
c1931-1935	-0.204	19	0.203	0.204	0.203	0.203	0.996	1.003	0.995	0.996
c1936-1940	-0.141	19	0.139	0.139	0.140	0.139	0.983	0.982	0.993	0.983
c1941-1945	-0.117	21	0.106	0.112	0.111	0.113	0.913	0.962	0.955	0.969
c1946-1950	-0.034	23	0.010	0.022	0.028	0.028	0.309	0.639	0.836	0.839
c1951-1955	-0.033	23	0.017	0.015	0.013	0.019	0.509	0.448	0.378	0.580
c1956-1960	-0.105	25	0.054	0.060	0.071	0.074	0.512	0.567	0.677	0.699
Primary completion										
c1916-1920	0.000		0.000	0.000	0.000	0.000				

c1921-1925	-0.057	19	0.064	0.060	0.057	0.057	1.117	1.047	0.995	0.995
c1926-1930	-0.035	23	0.032	0.035	0.035	0.036	0.918	1.017	1.007	1.043
c1931-1935	-0.224	20	0.225	0.223	0.224	0.223	1.005	0.995	1.001	0.996
c1936-1940	-0.145	20	0.139	0.144	0.144	0.144	0.961	0.992	0.995	0.996
c1941-1945	-0.117	22	0.117	0.117	0.117	0.117	0.994	0.996	0.996	1.001
c1946-1950	-0.029	22	0.015	0.021	0.024	0.026	0.514	0.706	0.829	0.897
c1951-1955	-0.018	27	0.005	0.013	0.013	0.014	0.306	0.727	0.741	0.791
c1956-1960	-0.018	29	0.002	0.007	0.012	0.013	0.091	0.390	0.667	0.721
Incomplete secondary										
c1916-1920	0.000		0.000	0.000	0.000	0.000				
c1921-1925	-0.027	27	0.004	0.023	0.023	0.023	0.144	0.829	0.829	0.829
c1926-1930	-0.022	17	0.030	0.020	0.027	0.027	1.381	0.919	1.214	1.214
c1931-1935	-0.245	21	0.236	0.243	0.241	0.243	0.964	0.992	0.986	0.993
c1936-1940	-0.160	22	0.152	0.159	0.159	0.158	0.951	0.998	0.997	0.993
c1941-1945	-0.136	23	0.129	0.132	0.132	0.133	0.948	0.974	0.977	0.982
c1946-1950	-0.013	31	0.006	0.008	0.009	0.009	0.435	0.593	0.690	0.727

134

c1951-1955	-0.008	33	0.002	0.002	0.003	0.005	0.236	0.213	0.396	0.660
c1956-1960	-0.016	28	0.005	0.010	0.014	0.016	0.279	0.624	0.849	0.942
Secondary completion or more										
c1916-1920	0.000		0.000	0.000	0.000	0.000				
c1921-1925	-0.044	18	0.086	0.046	0.046	0.030	1.977	1.045	1.045	0.682
c1926-1930	-0.045	26	0.005	0.028	0.039	0.042	0.107	0.631	0.857	0.932
c1931-1935	-0.225	22	0.227	0.233	0.229	0.228	1.007	1.035	1.015	1.011
c1936-1940	-0.169	23	0.168	0.175	0.176	0.175	0.991	1.034	1.041	1.034
c1941-1945	-0.089	24	0.085	0.088	0.085	0.084	0.953	0.981	0.948	0.945
c1946-1950	-0.016	31	0.003	0.005	0.009	0.012	0.170	0.330	0.521	0.698
c1951-1955	-0.019	32	0.005	0.000	0.005	0.008	0.285	0.009	0.262	0.420
c1956-1960	-0.047	26	0.024	0.043	0.047	0.046	0.512	0.916	0.989	0.971

135

Appendix 3-C. Marriage *P&R* Process by Education between the 1956–1960 Cohort and the 1981–1985 Cohort: Base Model

Birth cohort	Postponement (P)	Age at the trough	Recuperation (R) at age				Recuperation Index (RI = Rc/Pc)			
			30	35	40	45	30	35	40	45
Less than high school										
c1956-1960	0.000	13	0	0	0	0				
c1961-1965	-0.060	25	0.042	0.045	0.053	0.056	0.700	0.760	0.886	0.933
c1966-1970	-0.114	26	0.017	0.052	0.077	0.093	0.150	0.457	0.680	0.815
c1971-1975	-0.256	27	0.055	0.124	0.161		0.216	0.483	0.629	
c1976-1980	-0.377	27	0.078	0.201			0.207	0.533		
c1981-1985	-0.255	27	0.071				0.278			
High school graduation										
c1956-1960	0.000	13	0.000	0.000	0.000	0.000				
c1961-1965	-0.057	24	0.054	0.046	0.052	0.055	0.954	0.821	0.925	0.976
c1966-1970	-0.043	29	0.003	0.012	0.025	0.032	0.059	0.283	0.588	0.759
c1971-1975	-0.105	28	0.011	0.041	0.068		0.101	0.389	0.647	
c1976-1980	-0.234	28	0.041	0.119			0.175	0.507		

c1981-1985	-0.327	27	0.065				0.198			
Some college										
c1956-1960	0.000	13	0.000	0.000	0.000	0.000				
c1961-1965	-0.076	25	0.082	0.078	0.080	0.081	1.076	1.014	1.050	1.055
c1966-1970	-0.067	24	0.024	0.034	0.047	0.048	0.366	0.513	0.711	0.726
c1971-1975	-0.152	27	0.043	0.084	0.104		0.283	0.553	0.681	
c1976-1980	-0.289	27	0.064	0.185			0.222	0.640		
c1981-1985	-0.378	27	0.053				0.140			
Bachelor and above										
c1956-1960	0.000	13	0.000	0.000	0.000	0.000				
c1961-1965	-0.080	25	0.097	0.082	0.084	0.085	1.214	1.032	1.055	1.064
c1966-1970	-0.067	25	0.014	0.034	0.048	0.050	0.206	0.509	0.718	0.752
c1971-1975	-0.227	27	0.053	0.121	0.163		0.231	0.534	0.716	
c1976-1980	-0.372	28	0.084	0.229			0.225	0.614		
c1981-1985	-0.482	28	0.109				0.227			

Appendix 3-D. Marriage *P&R* Process by Education between the 1956–1960 Cohort and the 1981–1985 Cohort: Relational Model

Birth cohort	Postponement (P)	Age at the trough	Recuperation (R) at age				Recuperation Index (RI = R/P)			
			30	35	40	45	30	35	40	45
Less than high school										
c1956-1960	0.000	13	0.000	0.000	0.000	0.000				
c1961-1965	-0.060	25	0.042	0.045	0.053	0.056	0.700	0.760	0.886	0.933
c1966-1970	-0.081	28	0.002	0.033	0.051	0.064	0.025	0.413	0.633	0.789
c1971-1975	-0.142	27	0.039	0.072	0.084		0.271	0.506	0.589	
c1976-1980	-0.127	28	0.028	0.083			0.224	0.655		
c1981-1985	-0.026	19	0.140				5.455			
High school graduation										
c1956-1960	0.000	13	0.000	0.000	0.000	0.000				
c1961-1965	-0.057	24	0.054	0.046	0.052	0.055	0.954	0.821	0.925	0.976
c1966-1970	-0.039	29	0.001	0.019	0.026	0.030	0.036	0.474	0.658	0.772
c1971-1975	-0.070	27	0.016	0.037	0.051		0.230	0.525	0.724	
c1976-1980	-0.129	28	0.030	0.078			0.236	0.602		

c1981-1985	-0.094	27	0.025				0.264			
Some college										
c1956-1960	0.000	13	0.000	0.000	0.000	0.000				
c1961-1965	-0.076	25	0.082	0.078	0.080	0.081	1.076	1.014	1.050	1.055
c1966-1970	-0.048	29	0.000	0.015	0.025	0.026	0.008	0.307	0.524	0.536
c1971-1975	-0.107	27	0.040	0.071	0.077		0.371	0.666	0.724	
c1976-1980	-0.140	28	0.025	0.104			0.179	0.744		
c1981-1985	-0.105	29	0.004				0.039			
Bachelor and above										
c1956-1960	0.000	13	0.000	0.000	0.000	0.000				
c1961-1965	-0.080	25	0.097	0.082	0.084	0.085	1.214	1.032	1.055	1.064
c1966-1970	-0.070	30	0.000	0.035	0.047	0.048	0.000	0.496	0.668	0.691
c1971-1975	-0.169	27	0.047	0.096	0.123		0.279	0.566	0.729	
c1976-1980	-0.149	28	0.035	0.111			0.234	0.748		
c1981-1985	-0.109	28	0.026				0.235			

Appendix 4-A. Completed Fertility, Three Measures of Concentration, and Parity Distribution by Birth Cohort

Cohort	CF	CR	Kolm index	VMR	Parity distribution (%)					
					0	1	2	3	4	5+
c1921	5.75	0.26	0.35	1.24	2.2	3.7	7.3	8.0	10.2	68.5
c1922	5.65	0.26	0.34	1.20	2.0	4.1	5.9	10.1	10.9	66.9
c1923	5.64	0.24	0.29	1.02	1.7	3.4	6.3	8.1	11.5	69.0
c1924	5.48	0.26	0.31	1.15	2.3	4.5	6.7	8.3	12.8	65.5
c1925	5.50	0.24	0.28	1.00	2.0	4.0	6.1	8.4	10.6	68.8
c1926	5.43	0.24	0.27	0.99	1.7	4.1	5.7	8.9	11.9	67.6
c1927	5.57	0.24	0.28	0.98	1.7	4.0	4.7	9.0	11.5	69.0
c1928	5.39	0.23	0.25	0.92	1.5	3.4	6.4	7.9	12.8	68.0
c1929	5.25	0.23	0.23	0.87	1.6	3.4	5.7	9.6	14.2	65.5
c1930	5.15	0.23	0.23	0.87	2.3	3.8	4.6	8.9	15.4	64.9
c1931	4.97	0.24	0.23	0.93	3.1	4.2	5.5	8.6	16.4	62.2
c1932	4.83	0.24	0.22	0.89	3.0	4.0	6.4	9.5	17.6	59.5
c1933	4.85	0.22	0.19	0.78	1.8	3.9	4.7	10.7	21.5	57.4
c1934	4.68	0.22	0.18	0.77	2.9	3.3	5.2	11.7	21.8	55.0
c1935	4.62	0.22	0.17	0.72	2.0	3.5	5.4	12.5	23.9	52.7
c1936	4.30	0.23	0.16	0.74	1.5	3.7	7.8	19.8	24.7	42.4
c1937	4.15	0.23	0.14	0.70	2.0	3.7	9.4	19.4	24.3	41.2
c1938	4.10	0.22	0.13	0.65	1.1	3.5	10.5	21.6	25.8	37.5
c1939	3.98	0.23	0.13	0.68	1.6	4.6	10.1	22.7	25.8	35.2
c1940	3.85	0.23	0.13	0.66	2.0	4.6	10.8	24.5	26.5	31.7

c1941	3.68	0.22	0.11	0.62	2.3	4.6	11.2	28.5	27.0	26.5
c1942	3.54	0.22	0.11	0.60	2.2	4.9	14.0	29.5	27.3	22.2
c1943	3.40	0.22	0.10	0.59	2.0	5.0	17.0	32.2	24.5	19.3
c1944	3.25	0.22	0.09	0.55	2.9	4.0	18.6	36.1	24.1	14.4
c1945	3.11	0.23	0.09	0.58	3.1	5.2	22.8	34.4	21.9	12.6
c1946	2.99	0.22	0.08	0.51	2.3	5.6	26.0	36.8	19.0	10.2
c1947	2.91	0.22	0.07	0.48	2.0	5.8	29.3	37.8	16.1	9.1
c1948	2.79	0.22	0.07	0.50	2.7	6.1	33.8	35.4	14.0	8.0
c1949	2.69	0.22	0.06	0.47	2.9	6.4	36.5	35.0	13.6	5.7
c1950	2.60	0.23	0.06	0.48	3.2	7.4	39.7	33.1	10.7	5.9
c1951	2.48	0.22	0.06	0.46	3.1	9.9	41.8	31.4	10.5	3.4
c1952	2.41	0.20	0.05	0.38	2.8	8.4	46.9	31.5	8.0	2.4
c1953	2.29	0.21	0.04	0.39	3.7	9.3	52.3	26.0	6.7	2.0
c1954	2.22	0.21	0.04	0.41	4.4	10.1	54.7	23.3	5.5	2.0
c1955	2.15	0.20	0.04	0.38	3.9	11.6	57.7	20.8	4.7	1.3
c1956	2.07	0.20	0.04	0.35	4.0	13.4	59.5	18.6	3.5	0.9
c1957	1.98	0.20	0.03	0.34	5.5	13.5	62.6	15.3	2.3	0.7
c1958	1.97	0.20	0.03	0.34	5.2	14.0	63.3	14.5	2.2	0.8
c1959	1.92	0.19	0.03	0.31	5.1	15.4	64.5	12.6	2.1	0.2
c1960	1.89	0.19	0.03	0.30	5.7	14.9	65.7	12.1	1.3	0.3
c1961	1.90	0.20	0.03	0.32	6.0	15.3	64.2	12.4	1.7	0.4
c1962	1.89	0.20	0.03	0.32	6.2	15.4	64.0	12.7	1.2	0.4
c1963	1.90	0.20	0.03	0.33	6.8	13.9	64.5	12.8	1.6	0.3
c1964	1.87	0.20	0.03	0.33	7.4	14.4	64.1	12.7	1.2	0.1

c1965	1.85	0.20	0.03	0.33	7.9	14.1	64.7	12.0	1.1	0.1
c1966	1.91	0.21	0.04	0.37	6.7	15.1	62.2	13.1	2.2	0.6
c1967	1.89	0.22	0.04	0.39	7.7	14.5	61.9	13.3	2.0	0.5
c1968	1.87	0.22	0.03	0.37	7.6	15.7	61.2	13.1	2.1	0.3
c1969	1.82	0.23	0.04	0.39	8.9	16.6	60.0	12.8	1.5	0.2
c1970	1.73	0.24	0.04	0.40	9.8	20.7	57.4	10.9	1.0	0.2

Appendix 4-B. Completed Fertility, Concentration, and Parity Distribution by Five-Year Cohort and Level of Education

	c1921-25	c1926-30	c1931-35	c1936-40	c1941-45	c1946-50	c1951-55	c1956-60	c1961-65	c1966-70
Percent (%)										
Less than primary	65.3	50.8	30.5	16.4	8.2	3.8	2.5	1.1	0.7	0.5
Primary	28.3	38.5	53.5	52.5	48.2	34.6	25.0	12.8	5.1	1.7
Lower secondary	5.3	6.3	9.5	17.0	22.7	29.2	28.9	25.2	13.8	6.2
Upper secondary	0.5	3.5	5.6	10.8	15.7	24.9	33.2	46.1	53.2	53.0
Some college	0.4	0.4	0.5	0.9	1.3	1.6	3.9	5.5	8.5	15.5
Bachelor or more	0.4	0.5	0.4	2.5	4.0	6.0	6.4	9.3	18.7	23.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
CF										
Less than primary	5.82	5.71	5.15	4.68	4.04	3.50	2.57	2.01	1.66	1.71
Primary	5.31	5.16	4.83	4.29	3.73	3.18	2.65	2.21	2.05	1.99
Lower secondary	4.80	4.65	4.14	3.63	3.14	2.71	2.30	2.05	1.97	1.91
Upper secondary	4.07	4.19	3.72	3.18	2.80	2.44	2.10	1.91	1.89	1.90
Some college	4.76	3.42	3.19	2.71	2.46	2.20	2.05	1.80	1.80	1.82

Bachelor or more	3.04	3.51	2.95	2.74	2.51	2.14	1.90	1.75	1.77	1.70
Total	5.60	5.36	4.78	4.07	3.41	2.79	2.30	1.96	1.88	1.84
CR										
Less than primary	0.24	0.23	0.23	0.23	0.24	0.23	0.29	0.31	0.35	0.37
Primary	0.26	0.23	0.21	0.21	0.20	0.21	0.22	0.22	0.24	0.27
Lower secondary	0.26	0.22	0.22	0.22	0.21	0.21	0.20	0.19	0.21	0.26
Upper secondary	0.34	0.22	0.25	0.22	0.22	0.20	0.19	0.18	0.18	0.21
Some college	0.29	0.25	0.22	0.22	0.25	0.21	0.18	0.20	0.21	0.23
Bachelor or more	0.35	0.30	0.26	0.21	0.22	0.20	0.19	0.22	0.21	0.24
Total	0.25	0.23	0.23	0.23	0.23	0.22	0.21	0.20	0.20	0.22
Kolm Index										
Less than primary	0.32	0.28	0.24	0.19	0.16	0.12	0.09	0.07	0.06	0.07
Primary	0.30	0.23	0.17	0.13	0.10	0.08	0.06	0.05	0.05	0.06
Lower secondary	0.24	0.18	0.14	0.11	0.08	0.06	0.04	0.03	0.04	0.05
Upper secondary	0.29	0.14	0.15	0.08	0.07	0.05	0.03	0.03	0.03	0.03
Some college	0.30	0.12	0.09	0.06	0. 07	0.04	0.03	0.03	0.03	0.04

Bachelor or more	0.17	0.18	0.10	0.06	0.06	0.04	0.03	0.03	0.03	0.03
Total	0.31	0.25	0.20	0.14	0.10	0.07	0.05	0.03	0.03	0.04
VMR										
Less than primary	1.09	0.95	0.93	0.79	0.77	0.66	0.71	0.66	0.67	0.86
Primary	1.12	0.87	0.72	0.60	0.53	0.48	0.44	0.42	0.46	0.58
Lower secondary	1.03	0.76	0.65	0.60	0.51	0.43	0.36	0.32	0.38	0.50
Upper secondary	1.47	0.69	0.80	0.51	0.49	0.38	0.33	0.28	0.29	0.35
Some college	1.32	0.72	0.57	0.47	0.55	0.38	0.30	0.31	0.34	0.41
Bachelor or more	1.21	1.06	0.68	0.46	0.45	0.34	0.32	0.35	0.33	0.39
Total	1.12	0.94	0.82	0.69	0.60	0.50	0.41	0.33	0.33	0.39