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Research Article

Intergenerational transmission of women's educational attainment in South Korea: An application of a multi-group population projection model

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Bongoh Kye[1]

Abstract

Using a multi-group population projection model, this study examines the implications of educational mobility and differential demographic rates on changing women's educational distribution in South Korea. This article focuses on the implications of a differential population renewal process on educational mobility, which has not been extensively examined in previous studies of social mobility. My findings suggest, first, that differential demographic rates have no substantial influence on the educational distribution, because of substantial educational mobility. Second, that intergenerational association and structural change matter in the long run, with stronger intergenerational association and more structural change leading to increases in women's level of education. Finally, that educational mobility and differential fertility are interdependent processes that jointly influence differential population replacement, but the fertility gap between education groups would have to be unreasonably large to be influential, due to the extraordinarily high educational mobility in South Korea.

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1. Introduction: Demography and social mobility

This study examines intergenerational transmission of women's educational attainment in South Korea as a process jointly determined by educational mobility, differential fertility, and differential mortality. Most previous studies on social mobility have focused on intergenerational association in socioeconomic outcomes (e.g., education and occupation) based on existing parent–offspring dyads. Departing from this approach, this study examines the implications of differential demographic rates, intergenerational association, and structural change between generations for the transmission of socioeconomic status across generations as a whole.

First, the approach in most previous research has not fully examined how differential reproductive behaviors affect social mobility. Research in social mobility has applied a variety of statistical models, such as path analysis and structural equation models for status attainment process (Blau and Duncan 1967; Hauser, Tsai, and Sewell 1983), log-linear models for intergenerational occupational mobility (Erikson and Goldthorpe 1992; Hout 1984, 1988), and schooling progression-ratio models for educational attainment (Mare 1981; Shavit and Blossfeld 1993). All these models aim at estimating net intergenerational association in socioeconomic outcomes after controlling for potential confounders and change in marginal distributions. Although this approach demonstrates how offspring's socioeconomic outcomes depend on parental socioeconomic status, the implications of socioeconomic differentials in demographic behaviors for status transmission have not been widely studied. This is unfortunate, because intergenerational transmission of socioeconomic status is intrinsically "the process by which a socioeconomically differentiated population reproduces itself" (Mare 1997: 265).

Such recognition is not new – demographic models for social mobility were developed as early as the 1950s. Prais (1955) adopted a stable population theory to study social mobility, showing that occupational distributions approach a "stable-equivalent" state independent of the initial state when mobility rates remain constant over time. Although Prais recognized possible complications due to demographic processes, his model did not take into account differential fertility and mortality (Prais 1955: 80). Matras published a series of papers that incorporated differential demographic processes into social mobility. He applied Prais's model (1955) using empirical data (Matras 1960), incorporated differential fertility by occupation (Matras 1961), and examined the effect of fertility timing on population distribution in later periods (Matras 1967). These studies applied a multi-group population projection that assumes constant mobility and differential reproduction rates over a long period of time. Duncan (1966) also pointed out that groups with higher reproduction rates are over-represented in the next generation and that childless individuals are excluded from the mobility analysis. Despite this early recognition of the potentially important implications of differential reproduction rates in the social mobility process, these were largely overlooked in mobility research until Mare and his colleagues recently revived this approach (Mare 1997, 1996; Mare and Maralani 2006; Maralani and Mare 2008; Choi and Mare 2009; Kye and Mare 2009). These studies showed that differential demographic processes have a significant impact on educational distribution in next generations in diverse societies (e.g., United States, Indonesia, Mexico, and South Korea) and that intergenerational mobility is much more important than differential reproductive behaviors in determining educational distribution in the next generation. In other words, these studies found significant but modest impacts of differential reproductive behaviors on the distribution of socioeconomic outcomes in the next generations.

Second, previous studies have also not paid enough attention to structural change.[2] As in most mobility studies, I refer to structural change as change in marginal distribution of socioeconomic outcomes. Most research attempts to control for structural change in assessing the association between family background and socioeconomic outcomes, rather than exploring the implications of structural change for status transmission. The two most influential works in this field are exemplary in this regard. Erikson and Goldthorpe (1992) compared similarities and differences in the net associations between parental and offspring's occupations across countries, controlling for country-specific structural differences. Mare's "school transition model" (1981) examined how the association between educational attainment and family background changed in the United States over time, net of distributional change in educational attainment. These studies and their replications (e.g., Shavit and Blossfeld 1993) have shown geographic invariance and temporal stability of intergenerational associations, suggesting persistent inequality patterns in industrialized countries despite apparent diversity. Structural change between generations is typically treated as a confounder that masks genotypic intergenerational relationship (Featherman, Jones, and Hauser 1975). However, structural change itself should be crucial for differential population replacement. Greater educational expansion obviously entails higher levels of educational attainment in later periods if we hold constant the strength of the intergenerational association and differential demographic behaviors. In other words, differential demographic behaviors should not be influential in a society that

[2] Simkus (1984) is an exception. His study examined the impact of structural change on occupational mobility in Hungary under state socialist transformation. He classified the effects of structural change into discrepancy effects, concentration effects, and composition effects. Among them, discrepancy effects refer to how change in marginal distribution affects social mobility. The structural change examined in this study is the same as the discrepancy effect in Simkus (1984). However, I use "structural change" rather than "discrepancy effects" because the former is a much more widely used term.

experiences rapid educational expansion. How, then, does educational expansion affect educational distribution over the long term? It may be unreasonable to think of a society in which educational opportunities continue to increase through countless generations, because this society would eventually reach saturation point. But it is worth examining equilibrium distributions under various conditions of structural change, because this sheds light on the long-term implications of such structural changes. In this study, I examine the long-term implications of structural change on differential population replacement, which has received little attention in previous research.[3]

Finally, intergenerational associations have been interpreted in a somewhat limited way in most earlier studies. Intergenerational association has been interpreted as an indicator of social inequality, with a stronger association implying less social mobility. However, the implications of intergenerational associations for differential population replacement have not been studied. This is unfortunate, because intergenerational associations may affect differential population replacement under certain conditions. For example, if reproduction rates are higher for the less educated groups, a strong association implies that the level of education in the next generation would be dampened to some extent. Therefore the intergenerational association not only indicates the degree of social fluidity but also influences differential population replacement.

To overcome these limitations in previous research on social mobility and to fully understand differential population replacement, we need a model that simultaneously accounts for net association, structural change, and socioeconomic differentials in demographic behaviors. The current study builds upon Mare's work (1997), which developed such a model. Applying a multi-group population projection model, Mare demonstrated how the present distribution of educational attainment was influenced by educational mobility, differential fertility, and mortality of earlier periods in the United States. The first goal of the current study is to replicate Mare (1997) in the South Korean context. This context calls for such a comprehensive framework to understand simultaneous rapid socioeconomic development and demographic transition over the past half-century, which I will discuss in more detail in the following section.

Secondly, I extend Mare's model (1997) by projecting population distribution to equilibrium with constant mobility and demographic rates. Mare (1997) used transitory mobility and demographic rates to project educational distribution in the United States. He calculated projections forward to the present with the initial distribution and

[3] Some studies in educational mobility have examined the implications of structural change for the net association to a certain extent. Studies based on the Maximally Maintained Inequality hypothesis found that the intergenerational association is weakened when "a given level of education is saturated for the upper classes" (Hout, Raftery, and Bell 1993: 25). Although the implications of distributional change drew attention in the Maximally Maintained Inequality hypothesis, the main concern is still the net association. Distributional change matters only because it affects the net association.

transient demographic and mobility rates in the 20th century. This is a straightforward approach for those interested in understanding the implications of transient mobility and demographic rates for the current educational distribution when sufficient historical data are available. However, without historical data over a sufficiently long period, this projection would not be very illuminating. Unlike in the United States, such data sets are not available in South Korea. Therefore, to assess the implications of educational mobility and differential reproductive behaviors on the educational distribution in later periods, I rely on one of the most important theorems in mathematical demography: "stable population theory." This theory states that the age distribution in a closed population would reach "equilibrium" if the age-specific fertility and mortality rates remained constant over the long term (Keyfitz and Caswell 2005). Rogers (1995: 118–119) showed that "equilibrium" exists in multi-group cases if the mobility rates between groups as well as differential demographic rates remain constant.[4] The "stable model" is useful for examining the long-term implications of current demographic patterns and identifying the impact of each demographic element (fertility, mortality, and mobility) on population distribution (Preston, Heuveline, and Guillot 2001: 138). For example, if observed educational mobility rates and differential fertility rates yield the same "stable-equivalent" states as do observed mobility rates with (hypothetical) no differential fertility rates, this implies that the long-term implication of differential fertility is inconsequential. In other words, the equilibrium distribution is examined to understand the implications of current demographic and mobility rates for changing population distribution, although the assumption of unchanging demographic rates over the long term is certainly unrealistic and the equilibrium distribution may not be a good approximation of population distribution in the future. More simply, projection is used to understand current conditions rather than to forecast future conditions (Keyfitz and Caswell 2005: 271).

2. The South Korean context

Studying differential population replacement is particularly relevant in the South Korean context because of that nation's fundamental socioeconomic and demographic changes over the past 50 years. A recent study characterized such a transformation as "compressed modernization" (Chang 2010). While industrialization and demographic

[4] To reach "equilibrium," the transition matrix should be imprimitive. The conditions for "imprimitivity" are more complicated in multi-group cases than in single group cases (Rogers 1995). The transition matrix in this context could be primitive if fertility differential and immobility are extremely high. However, no transition matrix used in this study results in this extreme, so it has equilibrium distribution.

transition took more than a century in most Western countries, both were accomplished simultaneously in less than half a century in South Korea (see, e.g., Livi-Bacci 2006; Chang 2010). Such rapid and fundamental societal transformation has altered how socioeconomic resources are transmitted across generations. First, educational opportunity increased sharply and intergenerational association changed. While only a negligible proportion of women received some college education in 1960, 59 percent of women in 2005 did so (Korea Statistical Office 2008). This rapid educational expansion entailed exceptionally high rates of upward intergenerational mobility. For example, 45 percent of Korean people born between 1970 and 1985 whose fathers did not achieve a high school diploma receive at least some college education (Phang and Kim 2002: 208). Interestingly, the strength of intergenerational association in education remains quite stable, whereas the impact of family background on the educational transition at lower levels decreased more than the impact at higher levels did (Park 2003, 2007). This is consistent with the Maximally Maintained Inequality hypothesis, which stipulates that the chance of attaining a certain level of education among the lower classes increases only after upper-class people universally attain this level of education (Raftery and Hout 1993).

South Korea has also experienced a rapid decline in fertility since the 1960s. The total fertility rate (TFR) in 1960 was 6.0 and decreased to below the replacement level (2.1) in 1983. After modest gains in the 1990s the TFR again declined, reaching 1.1 in 2006, which was much lower than in most Western countries. In the meantime educational differentials in fertility have also changed. Until the 1980s a negative relationship between education and fertility existed: better-educated women produced fewer births than the less educated did. However, the patterns have changed since 1990. As of 2005 the least educated (primary education or less) women exhibit the lowest level of fertility, followed by college-educated women and women with a secondary education respectively (see Table A-1). Such a reversal is an interesting phenomenon, warranting further examination. However, it should not be of consequence for the current study, because the share of the population who receive only primary education is almost negligible in South Korea, while fertility differentials between the top two groups (secondary vs. tertiary) still exist. For example, less than 5 percent of reproductive women received only primary education in 2000 and 2005. Given that secondary education has been compulsory in South Korea since 1994 (Kim 2001), women with only primary education are likely to belong to negatively selected groups who may have mental or physical difficulties in pursuing further schooling, mating, and reproduction. Along with the changes in the direction of fertility differentials, the magnitude of fertility differentials also changed. While the least educated women on average had about one more child than college-educated women in 1980, the fertility differentials in 2005, which are reversed, are much smaller (see Table A-1).

In sum, South Korea experienced rapid educational expansion that yielded high upward intergenerational mobility and fast fertility decline with decreasing fertility differentials by education. This combination has a very interesting implication for differential population replacement. These two trends may offset each other in affecting women's educational distribution in the next generation. That is, differential fertility may slow the pace of educational expansion due to the higher reproduction rates of less educated women. However, this countervailing force should diminish as the educational differentials in fertility decrease over time. In this study, I assess the strength and interdependence of educational mobility and observed fertility differentials for the differential population replacement in South Korea.

3. Method: Multi-group population projection

A population renewal model (Mare 1996, 1997), based on multi-group population projection, allows us to examine the intergenerational transmission of women's educational attainment in South Korea, taking into account differential fertility and mortality. Using information on differential mortality and fertility and intergenerational educational mobility, we can construct a generalized Leslie transition matrix, M_t (Mare 1997: 274):

$$M_t = \begin{bmatrix} 0 & 0 & B_{10t} & B_{15t} & B_{20t} & B_{25t} & B_{30t} & B_{35t} & B_{40t} \\ S_{0t} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & S_{5t} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & S_{10t} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & S_{15t} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & S_{20t} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & S_{25t} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & S_{30t} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & S_{35t} & 0 \end{bmatrix} \quad (1)$$

S_{xt} s are squared sub-matrices of which elements are five-year age-specific survival and intragenerational mobility probabilities, and B_{xt} s are squared sub-matrices of which elements are five-year age-specific maternity rates and intergenerational mobility probabilities. The dimension of the sub-matrices is determined by the number of education groups. I classify education groups into three categories because of data limitations: primary and less, secondary, and tertiary education. In general, the multi-group projection model allows individuals to change their states at any time (Rogers 1995). However, I assume that educational attainment is determined at the time of birth because I rely on a series of aggregate cross-sectional data and do not have information on intragenerational educational mobility. Given my interest in the change in the overall educational distribution of women, this assumption should not be of consequence for the analysis. This implies that S_{xt} s are diagonal sub-matrices of which diagonal elements are five-year survival probabilities of each education group. B_{xt} s reflect educational differentials in fertility and educational mobility. A typical element in B_{xt} s is $({}_5F_x + ({}_5L_{x+5}/{}_5L_x)*{}_5F_{x+5})*E_{ij}$ where ${}_5F_x$ is the education-age-specific maternity rate, ${}_5L_x$ is the education specific person-years lived between age x and $x+5$, and E_{ij} is the outflow probability from education group i to j. Upon constructing a generalized Leslie transition matrix, we can calculate projected educational distribution 5×n years later:

$$P_n = (M_{n-1}) \cdots (M_2)(M_1)P_1 \qquad (2)$$

where P_1 is an initial population distribution by age and educational attainment

In this model, intergenerational transmission of women's educational attainment is understood as a two-step process: women from different educational backgrounds reproduce differently and then their daughters will be allocated differently. Differential reproduction rates as well as different mobility rates matter for this process. However, this model does not take into account some important demographic aspects involved in differential population replacement. First, this is a strictly one-sex model that looks at mother-to-daughter transmission only, so it does not account for the influence of assortative mating and the father's socioeconomic status on intergenerational transmission. Second, differential fertility matters in this study only because it affects differential reproduction. However, differential fertility would also matter for educational mobility, because sibship size affects educational attainment (Guo and VanWey 1999). I cannot incorporate these elements into the model mainly because of data limitations. Despite these limitations, the current approach is an improvement over most commonly used approaches in that it accounts for educational mobility as well as differential reproduction patterns.

4. Research questions

The following questions are examined in order to study the implications of educational mobility and differential fertility for the differential population replacement:

1. How does educational mobility affect the education distribution of women in the long run?
2. How does differential fertility by education affect the education distribution of women in the long run?
3. How do educational mobility and differential fertility jointly affect the education distribution of women in the long run?

To examine the implications of educational mobility for differential population replacement, I use observed and hypothetical educational mobility rates. Hypothetical mobility matrices include the independence mobility matrix and the no structural mobility matrix, and then there are sets of hypothetical association and inheritance matrices. First, the "independence mobility matrix" fits the marginal distribution to the observed mobility matrix and imposes no association between mother's and daughter's education. A projection using the independence mobility matrix yields a hypothetical distribution of women's education if there were no intergenerational association in women's education. Comparing the resulting distributions from this scenario with those from the observed mobility matrix gives us the influence of the intergenerational association on women's educational distribution. Second, the "no structural mobility matrix" is characterized by a mobility matrix where the intergenerational association is the same as the observed matrix, but the distribution of daughter's education is constrained to be equal to mother's education. This represents situations in which no structural change occurred and the association between mother's and daughter's education was equal to the observed association. Comparing this with the observed mobility matrix gives us the influence of structural change on the resulting distribution, controlling for the influence of the intergenerational association in education.[5] Finally, I examine how change in the intergenerational association affects differential population replacement by using a set of hypothetical educational mobility matrices in which I change the intergenerational association and inheritance gradually, holding the marginal distribution constant. This approach makes it possible to examine if higher intergenerational association and immobility imply a higher level of women's educational attainment in the subsequent generations, given observed differential

[5] In this model, marginal educational distribution cannot be consistent with the observed data because of educational expansion over the generations in the real world.

fertility and structural change over the generations. In the results section, I will discuss how to manipulate association, immobility, and marginal distribution in more detail.

To examine the implications of differential fertility for population replacement, I use five different sets of differential demographic rates: (1) observed differentials, (2) no differential fertility with observed differential mortality, (3) no mortality differential with observed differential fertility, (4) no mortality and fertility differential at all, and (5) a set of hypothetical differential fertility rates. A comparison between (1) and (2) will show the overall influence of differential fertility on population replacement. Given the very strong educational mobility and modest fertility differentials in South Korea, the influence of differential fertility is expected to be modest at best. Therefore I use hypothetical differential fertility rates to see how strong the differential fertility must be to influence the differential population replacement substantially. In the results section, I discuss how to manipulate hypothetical differential fertility rates in more detail.

I conclude by analyzing how educational mobility and differential demographic processes interact in differential population replacement. For example, if there were no educational mobility (perfect immobility), the influence of differential fertility would be great and groups with higher reproduction rates would prevail ultimately. By contrast, if upward mobility were prevalent, the influence of differential fertility would not be great. The portion of highly educated women in the next generation would be high, regardless of the level of differential fertility. I also examine how the implications of educational mobility and differential fertility are mutually dependent, using the hypothetical educational mobility and differential fertility rates.

5. Data

5.1 Fertility

To estimate age-specific fertility rates by education in South Korea, I use census and birth registration records between 1980 and 2005. From the census, I compute the number of women for five-year age groups and three education categories (less than primary education, at least some secondary education, and at least some college). This means that S_{xt} s and B_{xt} s in the transition matrix are 3×3 sub-matrices. More refined information has been available since 1990, but in order to ensure comparability across periods it is not used. Using the birth registration data, I compute the number of births by women's age and education between 1980 and 2005. Combining census and birth registration data, I compute age-specific fertility rates for each education group, as shown in Table A-1. Earlier childbearing for the less educated women than for the better educated is observed. Whereas women with primary education have more children until their early twenties, women with tertiary education have higher fertility rates in their early thirties. Such educational differentials in the timing of childbearing could exert downward pressure on the educational distribution of future generations if educational mobility were modest.

5.2 Mortality

The South Korean birth registration system does collect information about the educational attainment of the deceased, but this is not publicly available. Without access to this data set, differential mortality schedules cannot be computed directly. Instead, I combine life-table estimates provided by the Korea Statistical Office (www.kosis.kr) and a scholarly publication that reports mortality ratios by education (Kim 2002). Using the formula to convert mortality rates to survival probability in life tables[6] (Preston, Heuveline, and Guillot 2001: 49), I compute age-specific survival probabilities for each education group.[7] This is shown in Table A-1. Better educated women enjoy more favorable mortality conditions, but the difference between the groups is not great. Such modest differentials imply a weak effect of differential mortality on the population distribution.

5.3 Educational mobility

To compute educational mobility, I use the Korean Labor and Income Panel Study (KLIPS), an annual longitudinal survey representative of Korean individuals and households in urban areas (Phang et al. 1999). The KLIPS survey is an equal probability sample of households from seven metropolitan cities and urban areas, and was designed to cover 5,000 households and their members (aged 15 and over) in the first wave (1998). I use the fourth wave of data (2001), where mother's education was covered for the first time, through to the ninth wave (2006). Table 1 shows educational

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[6] $_nq_x = \frac{n \cdot {_nm_x}}{1+(n-{_na_x}) \cdot {_nm_x}}$ where $_nq_x$ is the probability of dying between age x and $x+n$, $_nm_x$ is the mortality rate between age x and $x+n$, and $_na_x$ is the person-year lived by the deceased between age x and $x+n$. The $_nq_x$ is given by life tables and $_na_x$ is assumed n/2. The $_nm_x$ is multiplied by mortality ratios of each education group to the overall population as presented by Kim (2002) to compute education-age-specific mortality rates, which are converted to survival probabilities.

[7] Because the mortality ratios by education are available only for women aged 25 and older, no mortality differential is assumed for women younger than 25.

mobility rates for different birth cohorts. We can observe that upward mobility becomes increasingly prevalent over time.

Table 1: Trends in educational mobility (percent)

	Daughter's education			
Mother's education	**Primary**	**Secondary**	**Tertiary**	**Total (N)**
Primary				
Cohort, 1950s	20.8	70.7	8.5	100.0 (993)
Cohort, 1960s	4.3	75.0	20.7	100.0 (957)
Cohort, 1970s	1.1	54.4	44.5	100.0 (659)
Secondary				
Cohort, 1950s	3.2	57.5	39.3	100.0 (65)
Cohort, 1960s	0.0	45.5	54.5	100.0 (205)
Cohort, 1970s	0.3	28.2	71.5	100.0 (760)
Tertiary				
Cohort, 1950s	[0.0]	[14.8]	[85.2]	[100.0] (10)
Cohort, 1960s	0.0	23.9	76.1	100.0 (21)
Cohort, 1970s	0.0	4.0	96.0	100.0 (77)

Sources: The Korean Labor and Income Panel Study (KLIPS), 2001–2006.
Notes: [ ]: based on less than 20 cases. Cohort refers to daughter's birth cohort.

Differential demographic rates are available for cohorts born between 1980 and 2005, as shown in Table A-1. However, educational mobility rates are not available for these years because most cohorts born during this period have not yet completed their schooling. To address these data limitations, I utilize the fact that we can reconstruct contingency tables uniquely when we know the marginal distributions and the odds ratios between origin and destination (Agresti 2002: 345–346).[8] Mother's educational distribution (origin) is available from the census data between 1980 and 2005, but daughter's educational distribution (destination) and intergenerational association are not directly available for this period. Here I make several assumptions to construct an

[8] This technique is called raking the table, or table standardization. First, I input the entries that satisfy the independence between origin and destination. Second, I use the observed log of joint frequencies of educational attainments of mothers and daughters as an offset in Poisson regression to get expected joint distribution of mother's and daughter's educational attainment. The resulting joint distribution yields a set of hypothetical educational mobility rates with imposed marginal and odds ratios.

educational mobility table. First, the educational distribution of women aged 20–24 in 2005, available from census data, is assumed to be equal to daughter's educational distribution for all years (1980–2005). This is a good approximation of educational distribution of daughters born between 1981 and 1985. Using this as daughter's educational distribution for 1980 and 1985 does not seem problematic, but it is probably inaccurate for later years. However, this assumption does not introduce a serious bias given the fairly high level of educational attainment for women born between 1980 and 1984.[9] Table A-2 shows the marginal distributions used in the analysis. Second, I substitute the intergenerational association of those born in the 1970s for those born between 1980 and 2005 in the projection models. This is equivalent to assuming that the intergenerational association for women born between 1980 and 2005 is the same as that for women born in the 1970s. Table A-3 shows the odds ratios between mother's and daughter's education for three birth cohorts. Consistent with previous studies (Park 2003, 2007), the intergenerational association did not change dramatically over cohorts; rather it fluctuated. This fluctuating pattern suggests that using the odds ratios observed for women born in the 1970s for later birth cohorts would not be overly problematic given the lack of any other reliable information. In summary, I create an educational mobility table based on (1) the intergenerational association observed for women born in the 1970s, (2) observed reproductive women's educational distribution of every five years (1980–2005) as mother's educational distribution, and (3) educational distribution of women aged 20–24 in 2005 as daughter's educational distribution.

6. Results

The analyses using the observed transitory mobility and differential demographic rates (not presented here but available upon request) show the following. First, projections using no differential demographic rates yield identical results with those using observed differential demographic rates, suggesting that differential demographic behaviors do not affect educational distribution during this period. This may be because the time span

[9] I considered imputing the missing information by extrapolation. However, about 75 percent of women aged 20–24 in 2005 received at least some college education and the annual increase for those having tertiary education among women aged 20–24 is 2 percent on average. This would imply that almost every woman born after 1995 had some tertiary education, which is unrealistic. Although neither assumption reflects the real trends well, using the educational distribution of women aged 20–24 in 2005 as the daughter's marginal distribution is more appropriate given (1) the already high proportion of women with tertiary education in 2005 and (2) the difficulty of opening new colleges or increasing the number of entrants to existing institutions in the short run.

is too short for differential demographic behaviors to be influential or because differential demographic behaviors are not large enough to make a difference. The analyses that project equilibrium distribution show that the latter is the case. I will discuss this in more detail in the next section. Second, without change in marginal distribution across generations the level of education would be much lower, which is hardly surprising. Third, without intergenerational association the level of education would be much lower. This suggests that intergenerational association in education also contributes to educational expansion: strong association yields a higher level of education in the next generation. However, the short time span that the projections rely on makes it difficult to draw a firm conclusion about this. The analyses that project equilibrium distribution are more suitable to examine this issue.

6.1 Equilibrium distribution under observed mobility and differential demographic rates

In this section, I discuss the results that use constant mobility and differential demographic rates. Three different mobility matrices (observed, independence, and no structural change) and four different sets of demographic rates (observed, no differential, fertility differential only, and mortality differential only) for each year yield 72 transition matrices. Each transition matrix has a left eigenvector that represents an equilibrium distribution implied by each set of mobility and demographic rates. Table 2 presents the results that use differential demographic rates in 1980, when such differentials are the largest among the periods covered. However, even differential fertility rates in 1980 do not affect the “stable-equivalent” states. In other words, differential fertility in South Korea between 1980 and 2005 is not strong enough to affect the equilibrium distribution of women’s educational attainment. But differential fertility is significant for the time it takes to converge to equilibrium. The last two columns in Table 2 show how long the convergence takes for each projection. We can see that no fertility differential yields faster convergence. This makes sense, because higher reproduction rates of less educated women delay educational expansion. Therefore observed fertility differentials are significant for differential population replacement in that they slow down the pace of reaching equilibrium.

Table 2: Equilibrium educational distribution of Korean women aged 15–44

	Marginal		Odds ratios*	Equilibrium distribution (%)			Years to reach equilibrium	
No.	Origin	Destination		Primary	Secondary	Tertiary	Observed differentials	No differentials**
Observed								
1	1980	20–24, 2005	O	.01	3.7	96.2	390	300
2	1985	20–24, 2005	O	.01	3.6	96.3	505	370
3	1990	20–24, 2005	O	.01	4.2	95.7	440	395
4	1995	20–24, 2005	O	.01	3.8	96.1	485	415
5	2000	20–24, 2005	O	.02	9.2	90.6	405	360
6	2005	20–24, 2005	O	.02	12.5	87.3	570	530
No association								
7	Any	1980	I***	35.7	55.9	8.4	240	300
8	Any	1985	I	20.6	67.5	12.0	295	370
9	Any	1990	I	11.6	69.8	18.6	375	395
10	Any	1995	I	5.7	62.3	32.0	345	415
11	Any	2000	I	3.3	54.2	42.5	395	345
12	Any	2005	I	1.3	44.7	53.9	480	530
No structural change								
13	1980	1980	O	37.1	55.8	7.2	230	300
14	1985	1985	O	20.8	68.7	10.6	275	370
15	1990	1990	O	11.9	67.2	20.9	380	395
16	1995	1995	O	5.4	65.9	28.7	385	415
17	2000	2000	O	3.2	59.0	37.9	395	375
18	2005	2005	O	1.3	47.5	51.2	455	530

Notes: * O: observed odds ratios; I: Independence of mother's and daughter's education, or no association.
** Equilibrium distribution implied by observed fertility differentials and no fertility differentials are similar to each other. The differences lie only in how long it takes to reach equilibrium distribution.
*** If no intergenerational association exists, marginal distribution in origin does not influence the projection. Marginal distribution in destination matters only because this completely determines the outflow rates regardless of marginal in origin.

The first panel in Table 2 (Nos. 1–6) shows the equilibrium distribution by assumed marginal distribution and intergenerational association, and observed differential mortality and fertility. Two patterns are worth noting. First, the equilibrium distribution is heavily skewed to the high end: if current educational mobility persists over a long period of time, around 90 percent of women would have a tertiary education, which is much higher than the initial destination distribution (75.1 percent, see Table A-2). This contrasts with IQ projection results, in which the level at the equilibrium is only modestly different from the initial level (Preston and Campbell 1993). Such a difference is due to different patterns of intergenerational transmission or mobility. Whereas the mean levels of IQ for offspring generation are not radically different from those of their parents (Preston and Campbell 1993: 1002, Table 2), the South Korean daughters attained a much higher level of education than their mothers on average. Such strong upward educational mobility in South Korea explains why the level of education at the equilibrium is so high. Second, the level of women's education implied by the later period is a bit lower than the earlier periods imply. This may seem counterintuitive, given the educational expansion observed between 1980 and 2005. However, this is the case because origin distributions in the later periods are imposed to be more similar to the destination distribution than those in the earlier periods. While only 8.2 percent of reproductive women in 1980 had tertiary education, more than half of reproductive women in 2005 did so (see Table A-2). Obviously, the latter is closer to the assumed destination distribution (educational attainment of women aged 20–24 in 2005). Because the destination distribution may not be equal to educational attainments of daughters at each time point,[10] the comparison between projections would not reveal the trend in differential population replacement. Instead, this tells us about the implications of structural change for the equilibrium distribution. Because the impact of differential demographic rates is minimal and I use the same odds ratios for all these projections, the differences in marginal distribution of mother's education are largely responsible for the differences among the equilibrium distribution of each projection. The higher level of educational attainments obtained from the projections with earlier distribution implies that greater structural change increases educational attainment. However, the magnitude is not large. There is only a 10 percent difference in tertiary education levels between the projection with marginal distributions in 1980 and the marginals in 2005. Given the fairly large difference in the marginal distribution of origin, this difference seems modest at best. This implies that the change in marginal distribution experienced between 1980 and 2005 does not have substantial implications for the differential population replacement process in South Korea.

The second and third panels in Table 2 display equilibrium distributions under independence and with no structural change. Under independence (Nos. 7–12), marginal distribution in origin does not make any difference in outflow mobility rates. The marginal distribution in the destination solely determines the mobility rates, because daughter's educational attainment is not at all dependent on the level of mother's education and is only constrained by the initial destination distribution of each projection. Interestingly, the equilibrium distribution is almost identical to the initial destination distribution. This implies that educational expansion would stop when it reaches the initial marginal distribution of destination. Without intergenerational association, the initial destination distribution determines the equilibrium distribution. When I use the educational distribution of women aged 20–24 in 2005 as the initial destination distribution and assume independence, about 75 percent have tertiary education at the equilibrium (not reported in Table 2), which is much lower than those reported in the first panel in Table 2. This means that the lack of intergenerational

[10] It is likely to underestimate the level of daughter's education because it assumes that the level does not increase after 2005.

association would lower the level of educational attainment at equilibrium, holding other things constant. This finding leads us beyond the narrow interpretation of intergenerational association in previous research: intergenerational association is not only a measure of social inequality but also contributes to educational expansion.

The equilibrium distributions under assumptions of no structural change (Nos. 13–18) are very similar to the marginal distributions of destination (i.e. the same as origin) used in the mobility matrix. Strength of intergenerational association does not matter at all for the educational distribution in the future, simply because the educational distribution does not change over time.[11] Therefore equilibrium is identical to the initial destination distribution in the mobility matrix unless differential demographic patterns are excessively influential.[12] From these projections we can conclude that (1) structural change does not matter for differential population replacement under independence and (2) intergenerational association has no implication for differential population replacement under no structural change. In other words, some structural change is necessary for the intergenerational association to affect the differential population replacement, and vice versa.

6.2 Equilibrium distribution under hypothetical educational mobility and differential fertility conditions

In the multi-group population projections discussed above, observed differential fertility does not have a big impact on equilibrium distributions. Differential fertility influences only the time to convergence. I also found that intergenerational association contributes to educational expansion by comparing the equilibrium distributions implied by two mobility matrices: observed and independence. In this section, I extend the analyses by using hypothetical mobility and differential fertility conditions. First, I compare the equilibrium distributions implied by hypothetical differential fertility conditions under the observed mobility conditions. This analysis will allow for examining how strong differential fertility must be to influence the equilibrium distribution. Second, I compare the equilibrium distributions implied by different mobility conditions under the observed differential fertility. By manipulating the odds ratios and the percentage of immobility in the mobility matrix, I examine the implications of net association and inheritance for equilibrium distribution. Third, I examine how the impact of intergenerational association is dependent on differential fertility: that is, would the

[11] Prais (1955) proved this property mathematically without considering differential demographic processes.
[12] This is why the equilibrium distributions under independence and no structural change are similar to each other.

intergenerational association be more influential on the equilibrium distributions if differential fertility were weaker?

6.2.1 Impact of differential fertility on equilibrium distribution

Following Preston and Campbell (1993), I impose hypothetical differential fertility patterns on the population projection and compare the equilibrium distributions implied by each projection. The results are shown in Table 3. The first column shows the hypothetical fertility ratios between the adjacent education groups used in the projections. For example, a fertility ratio of 1.5 means that the age-specific fertility ratio of primary education to secondary or secondary to tertiary is equal to 1.5. I further assume that age-specific fertility rates for women with secondary education are the same as average age-specific fertility rates in 2005.[13] I use the educational distribution of reproductive women in 2005 as the origin distribution, with women aged 20–24 in 2005 as the destination distribution, and observed odds ratios of women born in the 1970s as the intergenerational association. The equilibrium distribution implied by each projection shows the negative relationship between differential fertility and the educational attainment at the equilibrium: whereas 88 percent of women will attain a college education under no differential fertility, only 65 percent will do so if the fertility ratio between adjacent groups is 5.0. This difference is substantial in the equilibrium distribution, but fertility differentials should be much smaller than this in most societies. In Table 3 we can see that a fertility ratio of 1.5 does not have a substantial impact on equilibrium distribution. However, even this level of fertility differential is unrealistically large; it is much greater than observed differentials in South Korea (see Table A-1). This explains why differential fertility does not influence the equilibrium distribution under the observed educational mobility in South Korea. In a situation where upward educational mobility is dominant, differential fertility must be unrealistically strong to be influential. This confirms the dominance of educational mobility in differential population replacement in South Korea.

[13] The choice of reference fertility rate does not affect the equilibrium distribution, so this choice does not make a difference in this exercise.

Table 3: Impact of differential fertility on the equilibrium educational distribution* (percent)

Fertility ratios	Primary	Secondary	Tertiary
No differential	.02	11.7	88.0
1.5	.02	15.5	84.3
2.0	.02	19.9	79.9
2.5	.03	24.1	75.7
3.0	.03	27.5	72.3
3.5	.03	30.1	69.6
4.0	.03	32.2	67.5
4.5	.03	33.8	65.9
5.0	.03	35.1	64.6

Notes: * Odds ratios: observed for women born in 1970s. Origin: women 15–44 in 2005. Destination: women 20–24 in 2005. Reference fertility rates: 2005.

6.2.2 Impact of intergenerational association on equilibrium distribution

In the previous sections I examined the impact of intergenerational association on equilibrium distribution by comparing the equilibrium distributions implied by two mobility matrices: observed and independence. The difference between the two equilibrium distributions is substantial, suggesting the strong impact of the intergenerational association on the equilibrium. However, this comparison is somewhat limited because the equilibrium distribution under independence is determined solely by the destination distribution in the mobility matrix. To make a more sensible assessment of the impact of the intergenerational association on population replacement, I examine the implications of changing (1) odds ratios and (2) immobility for the equilibrium distribution. In mobility studies using log-linear models, odds ratios are used to represent the net association between origin and destination after controlling for difference in marginal distributions. By multiplying the observed odds ratios by scaling factors and comparing implied equilibrium distributions, I can examine the relationship between the net intergenerational association and the level of educational attainment at equilibrium. I fit three log-linear models to estimate the net association between mother's and daughter's education: saturated, row effect, and uniform association model.[14] The uniform association model fits the data best, so I use the parameter estimates from this model for the following simulations. Parameter estimates and the Bayesian Information Criterion (BIC) for model comparison are given in the Appendix (see Table A-4). The uniform association model assumes that the differences between adjacent categories are equal, and the log of odds ratios involving any two pairs (row *i* and *i'*, and column *j* and *j'*) are equal to β_{UA} $(i - i')(j - j')$ (Power and Xie 2000). The anti-log of estimated uniform association parameter ($e^{\beta_{UA}}$) is 3.287, which means that daughters of women with tertiary education (or secondary education) have 229 percent higher odds of having one category higher education (secondary vs. primary or tertiary vs. secondary) than daughters of women with secondary education (or primary education). In simulations, I multiply $e^{\beta_{UA}}$ by scaling factors that vary from 1/3.287 (independence) to 3.287 (extremely strong association) and standardize the marginal distribution using mother's and daughter's educational distribution in 1980. I then compare the equilibrium distributions implied by (hypothetical) scaled mobility matrices.

I also examine the impact of immobility or inheritance on the population replacement. Immobility or inheritance is closely related to net association, but high immobility does not necessarily imply strong association, or vice versa.[15] For example, consider the educational mobility table used in this study (3×3 mobility table). Let us denote f_{ij} as the number of daughters whose mothers' education is *i* and whose own education is *j* (*i*=1, 2, 3 and *j*=1, 2, 3). Then suppose that most daughters have the same level of educational attainment as their mothers (i.e., f_{11}, f_{22}, and f_{33} are large). This implies strong inheritance. However, this does not necessarily mean that all odds ratios in this mobility table are high. For example, $(f_{12}f_{23})/(f_{13}f_{22})$ could be close to 1 or even smaller than 1, meaning that daughters of women with secondary education would not be more likely to enter college than daughters of women with primary education. Therefore net association (measured by odds ratios) and immobility are analytically

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[14] The row effect model and uniform association model can be written as follows. Row effect model: $\log F_{ij} = \mu + \mu_i^R + \mu_i^C + j\phi_i$; uniform association model: $\log F_{ij} = \mu + \mu_i^R + \mu_i^C + \beta x_i y_j$ where *i*=1,2,3 and *j*=1,2,3, μ_i^R and μ_i^C represent row marginal and column marginal parameters respectively, ϕ_i is scaled scores for origin - here dummy-coded - and x_i and y_j are integers that represent the order of origin and destination. The uniform association model assumes the linear effect of mother's education on a log of odds of attaining higher level education, but the row effect model does not impose this assumption.

[15] This is the case except for 2×2 mobility tables. In 2×2 mobility tables, strong association necessarily implies high proportion in diagonal cells (i.e., higher immobility).

distinguishable concepts,[16] so the implications of immobility would be different from net association. I manipulate percentage of immobility, using the assumed marginal distribution in 1980. A set of hypothetical mobility matrices is created as follows. First, I assume uniform distributions of origin and destination. Second, I change percentage of immobility from 33 percent (which represents independence) to 90 percent (which represents extremely high immobility), assuming symmetry.[17] Third, I compute the sets of odds ratios for each hypothetical mobility matrix. Then I substitute the assumed marginal distributions of 1980 for the uniform distribution. This substitution is necessary, because the uniform distributions of both origin and destination imply no structural change where we cannot evaluate the implication of intergenerational association.[18] Finally, I compute the outflow educational mobility rates from each matrix and apply these to the projection. I use differential demographic rates in 1980.

Figure 1 shows how educational distribution at equilibrium is related to levels of association (Panel A) and immobility (Panel B). From the two graphs, we can see that stronger association and higher immobility lead to higher educational attainment at equilibrium given the observed differential demographic rate in 1980. Therefore stronger intergenerational association and inheritance not only represent greater educational inequality but also promote educational expansion. This is because the stronger association and inheritance imply more upward mobility when structural change exists. The policy implications of this result are somewhat problematic: educational equality may exert negative influence on the level of educational attainment in the future. This suggests the difficulty of pursuing socioeconomic development while minimizing socioeconomic inequality. Of course, the causal order is not straightforward. Alternatively, educational expansion leads to stronger intergenerational association, resulting in the positive relationship between them. However, the previous studies suggest that educational expansion weakens intergenerational association when a certain level of education is saturated by the upper class (Hout, Raftery, and Bell 1993; Raftery and Hout 1993). This evidence suggests that the positive association is unlikely to be driven by the reverse causation. I will discuss this issue in more detail in the conclusion.

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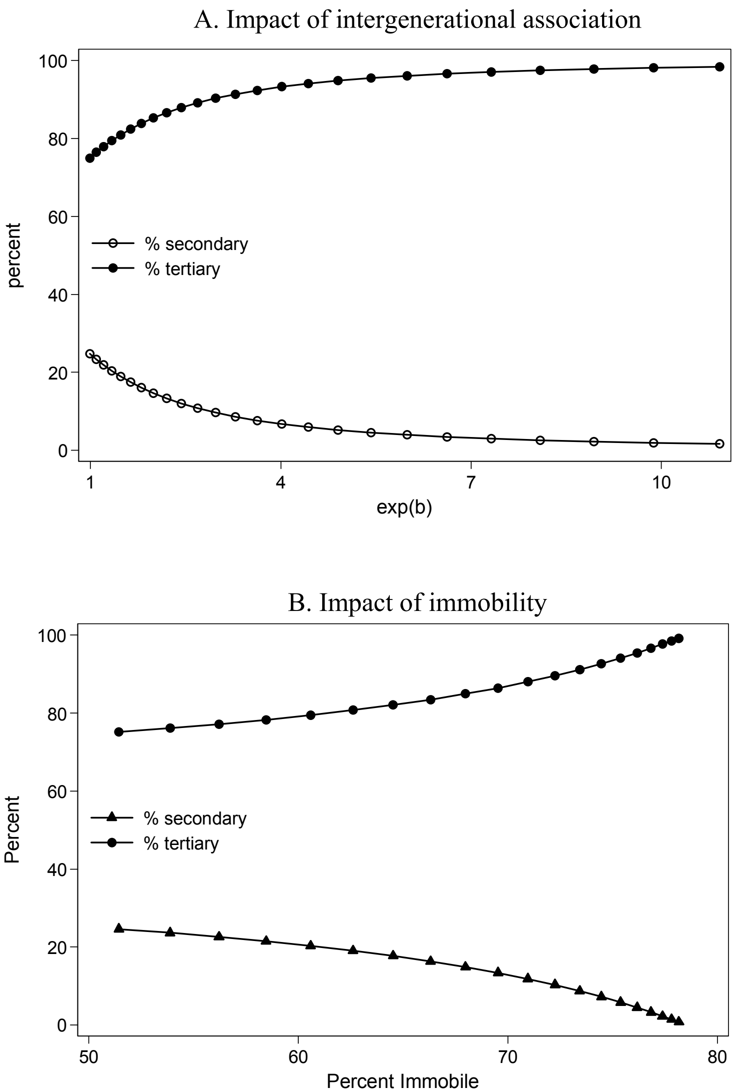
[16] Occupational mobility studies account for the impact of immobility or inheritance by developing kinds of "diagonal-blocked" models (Erikson and Goldthorpe 1992; Hout 1984, 1988; Sobel, Hout, and Duncan 1985). The aim of this approach is to estimate the net association, controlling for inheritance, or vice versa.

[17] Although symmetry is an unrealistic assumption given the secular trend of educational expansion over time, I impose it because of the ease of fixing the marginal distribution under this assumption. Given the interest in evaluating the implications of immobility on differential population replacement, this assumption is inconsequential to the results.

[18] This substitution makes the percentage of immobility vary 50 to 80 percent instead of 33 to 90 percent.

Figure 1: Impact of association and immobility on the equilibrium educational distribution*



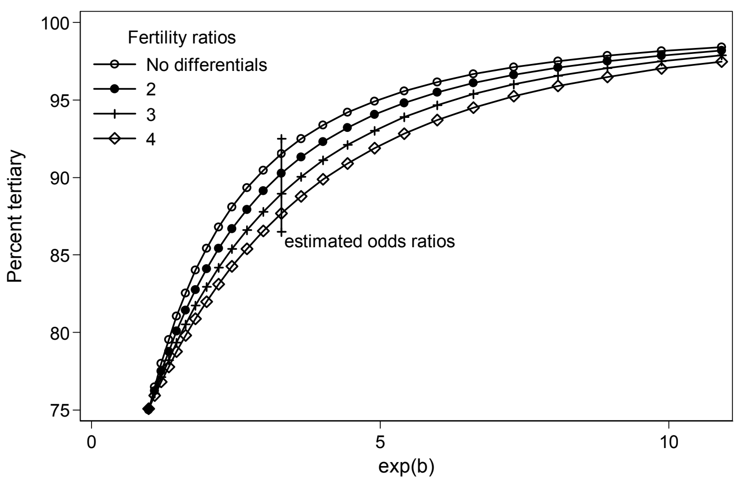
Notes: * Hypothetical educational mobility and observed differential fertility in 1980.

6.2.3 Joint impact of mobility and differential fertility

Table 4 shows the impact of differential fertility on differential population replacement and Figure 1 shows the positive impact of net association and inheritance on the level of educational attainment at equilibrium. In this section, I examine the extent to which the impact of net association and inheritance depends on differential fertility. Whereas Panel A in Figure 2 shows how the impact of association is dependent on the level of fertility differentials, Panel B shows how the relationship between inheritance and the level of educational attainment at equilibrium depends on the differential fertility.[19]

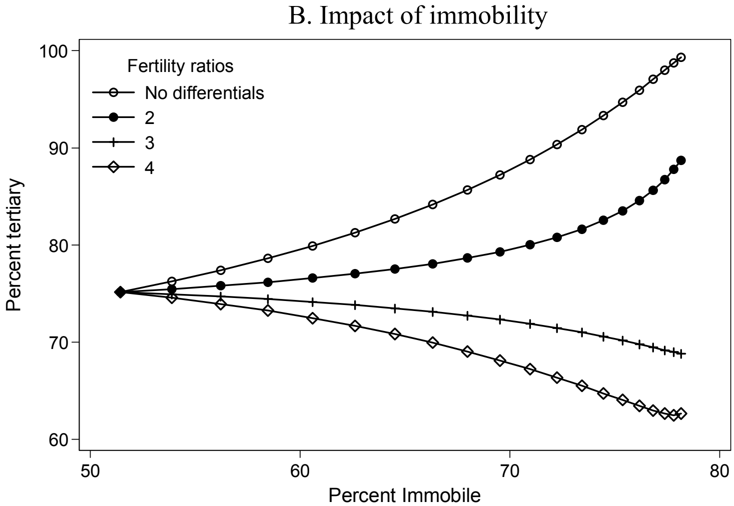
Figure 2: Effect of educational mobility and differential fertility on the equilibrium educational distribution*

A. Impact of intergenerational association



[19] The impact of net association, inheritance, and differential fertility is examined in the same way as in Figure 1.

Figure 2: (Continued)*



Notes: * Origin: 1980, destination: 20–24 in 2005, reference fertility rates in 1980.

We can see that a stronger intergenerational association leads to more educational upgrading, although the existence of strong differential fertility pulls down the level of educational attainment at equilibrium to some extent (see Panel A). Actually, the impact of differential fertility on the relationship between net association and the percentage of tertiary education is the strongest at the observed level of net association, and negligible when there is no association or an extremely strong association. However, the patterns are the same and the impact of differential fertility is not substantial.

By contrast, we can see that the impact of inheritance on differential population replacement is dependent on the level of fertility differentials (Panel B). Stronger immobility implies more educational expansion if fertility ratios between adjacent education groups are smaller than 2.0. If fertility ratios are greater than 3.0, more inheritance yields lower educational attainment. This means that the higher reproduction rates of the less educated women would push the educational attainment down when educational immobility is prevalent. This is a concern raised in *Bell Curve* (Herrnstein and Murray 1994), which has been widely examined and criticized (Fisher et al. 1996). The projection results provide further evidence against their claim, because the downward trend is only the case if fertility ratios are greater than 3.0 and inheritance is extremely strong. Neither of these conditions is likely to be confirmed by empirical data, which shows that Herrnstein and Murray's claim does not have support from demographic analysis.

The analysis above shows an interesting contrast between the impact of net association on equilibrium distribution and that of inheritance when differential fertility is extremely high (e.g., fertility ratio higher than 3.0). Whereas stronger association still leads to a higher level of educational attainment at the end, higher inheritance exerts downward pressure on the equilibrium distribution. This illustrates a subtle distinction between inheritance and net association. Strong inheritance lowers the level of educational attainment at equilibrium when fertility differential is high, because a huge inflow of the offspring of the less educated offsets the trend of upward educational mobility. Why, then, does strong association have the opposite implication under a high fertility differential? This is because strong association yields high enough upward mobility rates to cancel out the downward pressure of high differential fertility. Therefore concerns like "population dysgenesis" are even more groundless when we think of intergenerational transmission in terms of association instead of inheritance. Stronger association yields a higher level of educational attainment even with the extremely higher reproduction rate of less educated women compared to that of the better educated.

7. Conclusion

Using a multi-group population projection model, I studied the implications of educational mobility and differential demographic rates on differential population replacement in South Korea. First, I found that differential demographic rates do not greatly influence differential population replacement. Projections using observed demographic rates yield the same educational distributions as those using (hypothetical) no differential demographic rates, holding constant educational mobility rates. As shown in Table 4 and Figure 2, differential fertility must be unrealistically large to influence differential population replacement. This result suggests that differential demographic rates are not important in the population distribution in the long run under conditions of substantial social mobility, and is consistent with the findings of previous studies (Mare 1997; Musick and Mare 2004; Preston and Campbell 1993). However, the level of outcome at equilibrium is much higher than in other studies, due to high rates of upward intergenerational mobility. Second, I found that structural change matters for differential population replacement: that is, the greater the structural change, the higher the educational attainment at equilibrium. However, the influence of structural change is not found to be large. Even the substantial educational upgrading in South Korea between 1980 and 2005 implies only modest increases in the percentage of women with tertiary education at equilibrium (see Table 2). Finally, I found that intergenerational association and inheritance had a significant impact on differential population replacement: stronger association and inheritance imply more educational expansion. This result leads us beyond a narrow interpretation of intergenerational association, which in most studies is interpreted as an indicator of social inequality. For example, stability of intergenerational association in educational attainment has been used as evidence for "persistent inequality" (Shavit and Blossfeld 1993). However, the current study shows that strong intergenerational association and inheritance also promote educational expansion unless fertility differentials are extremely high.

Among these findings, the positive relationship between intergenerational association and educational expansion is worthy of further discussion. On the one hand, the positive association between them provides evidence that societal development does not necessarily reduce social inequality. Instead, this finding suggests that greater inequality would promote socioeconomic development under certain circumstances: specifically, modest differences in reproduction rates by socioeconomic groups and stable intergenerational mobility regimes. This suggests an intrinsic trade-off between socioeconomic development and reduction of social inequality.

On the other hand, almost every woman would attain the highest level of educational attainment at equilibrium if intergenerational association or inheritance is strong. However, this does not imply educational inequality will disappear in the future. Instead, qualitative distinction among tertiary education is likely to emerge. Actually, the increase in enrollment to two-year colleges is one of the driving forces of educational expansion in South Korea, and family background differentials between four-year college and two-year college entrants have been increasing over time (Park 2007). This is consistent with the Effectively Maintained Inequality (EFI) hypothesis, which expects increasing differentiations among educational institutions when a certain level of education is saturated for offspring from advantageous origin and open to the disadvantaged people (Lucas 2001). Therefore the extremely high level of educational attainment at equilibrium should be interpreted with caution.

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References

Agresti, A. (2002). *Categorical Data Analysis*. New York: Wiley. doi:10.1002/0471249688.

Blau, P.M. and Duncan, O.D. (1967). *The American Occupational Structure*. New York: Wiley.

Chang, K. (2010). *South Korea under Compressed Modernity: Familial Political Economy in Transition*. New York: Routledge.

Choi, K.H. and Mare, R.D. (2009). International Migration of Mexicans and the Reproduction of Education from One Generation to the Next. Paper presented at the Population Association America 2009 Annual Meeting at Detroit, MI.

Duncan, O.D. (1966). Methodological Issues in the Study of Social Mobility. In: Lipset, S.M. and Smelser, N.J. (eds.). *Social Structure and Mobility in Economic Development*. Aldine, Chicago: 51-97.

Erikson, R. and Goldthorpe, J.H. (1992). *The Constant Flux: A Study of Class Mobility in Industrial Societies*. Oxford: Clarendon Press.

Featherman, D.L., Jones, F.L., and Hauser, R.M. (1975). Assumptions of Social Mobility Research in the US: The Case of Occupational Status. *Social Science Research* 4(4): 329-360. doi:10.1016/0049-089X(75)90002-2.

Fisher, C.S., Hout, M., Jankowski, M.S., Lucas, S.R., Swindler, A., and Voss, K. (1996). *Inequality by Design: Cracking the Bell Curve Myth*. Princeton: Princeton University Press.

Guo, G. and VanWey, L.K. (1999). Sibship Size and Intellectual Development: Is the Relationship Causal? *American Sociological Review* 64(2): 169-187. doi:10.2307/2657524.

Hauser, R.M., Tsai, S., and Sewell, W.H. (1983). A Model of Stratification with Response Error in Social and Psychological Variables. *Sociology of Education* 56(1): 20-46. doi:10.2307/2112301.

Herrnstein, R.J. and Murray, C. (1994). *Bell Curve: Intelligence and Class Structure in American Life*. New York: Free Press.

Hout, M. (1984). Status, Autonomy, and Training in Occupational Mobility. *American Journal of Sociology* 89(6): 1379-1409. doi:10.1086/228020.

Hout, M. (1988). More Universalism, Less Structural Mobility: American Occupational Structure in the 1980s. *American Journal of Sociology* 93(6): 1358-1400. doi:10.1086/228904.

Hout, M., Raftery, A.E., and Bell, E.O. (1993). Making the Grade: Educational Stratification in the United States, 1925 – 1989. In: Shavit, Y. and Blossfeld, H. (eds.). *Persistent Inequality*. Boulder: Westview Press: 25-50.

Keyfitz, N. and Caswell, H. (2005). *Applied Mathematical Demography, 3rd edition*. New York: Springer.

Kim, D.Y. (2001). What should be reformed in compulsory secondary education? *Welfare Trends March*: 36-38 (in Korean).

Kim, T.H. (2002). Mortality. In: Kim, D., Park, S., and Eun, K. (eds.). *Population in Korea*. Korea National Statistical Office: 115-152 (in Korean).

Korea National Statistical Office (2008). Census Tabulation. [electronic resource] Seoul: http://www.kosis.kr.

Kye, B. and Mare, R.D. (2009). Intergenerational Effects of Shifts in Women's Educational Distribution in South Korea: Transmission, Differential Fertility, and Assortative Mating. Los Angeles: California Center for Population Research (CCPR-023-09).

Livi-Bacci, M. (2006). A *Concise History of World Population. 3rd edition*. Oxford: Blackwell Publishers Ltd.

Lucas, S. (2001). Effectively Maintained Inequality: Educational Transitions, Track Mobility, and Social Background Effects. *American Journal of Sociology* 106(6): 1642-1690. doi:10.1086/321300.

Maralani, V. and Mare, R.D. (2008). Unobserved Heterogeneity, Demographic mechanisms, and the Intergenerational Effects of Increasing Women's Schooling. Paper presented at the Population Association America 2008 Annual Meeting at New Orleans, LA.

Mare, R.D. (1981). Change and Stability in Educational Stratification. *American Sociological Review* 46(1): 72-87. doi:10.2307/2095027.

Mare, R.D. (1996). Demography and the Evolution of Educational Inequality. In: Baron, J.N., Grusky, D.B., and Treiman, D. (eds.). *Social Differentiation and Social Inequality*. Colorado: Westview Press: 117-151.

Mare, R.D. (1997). Differential Fertility, Intergenerational Educational Mobility, and Racial Inequality. *Social Science Research* 26(3): 263-291. doi:10.1006/ssre.1997.0598.

Mare, R.D. and Maralani, V. (2006). The Intergenerational Effects of Changes in Women's. Educational Attainments. *American Sociological Review* 71(4): 542-564. doi:10.1177/000312240607100402.

Matras, J. (1961). Differential Fertility, Intergenerational Occupational Mobility, and Change in the Occupational Distribution: Some Elementary Interrelationships. *Population Studies* 15(2): 187-197. doi:10.2307/2173315.

Matras, J. (1967). Social Mobility and Social Structure: Some Insights from the Linear Model. *American Sociological Review* 32(4): 608-614. doi:10.2307/2091028.

Matras, J. (1960). Comparison of Intergenerational Occupational Mobility Patterns: An Application of the Formal Theory of Social Mobility. *Population Studies* 14(2): 163-169. doi:10.2307/2172012.

Musick, K. and Mare, R.D. (2004). Family Structure, Intergenerational Mobility, and the Reproduction of Poverty: Evidence for Increasing Polarization? *Demography* 41(4): 629-648. doi:10.1353/dem.2004.0034.

Park, H. (2003). Educational Expansion and Inequality in Korea. *Research in Sociology of Education* 14: 33-58. doi:10.1016/S1479-3539(03)14003-7.

Park, H. (2007). South Korea: Educational Expansion and Inequality of Opportunity for Higher Education. In: Shavit, Y., Adrum, R., and Gamoran, A. (eds.). *Stratification in Higher Education: A Comparative Study*. Stanford: Stanford University Press: 87-112.

Phang, H., Ahn, J., Chang, J., Park, E., Ho, J., and Jung, H. (1999). Korean Households' and Individuals' Economic Activities: Data Analysis of the 1st wave of Korean Labor and Income Panel Study. Korean Labor Institute (in Korean).

Phang, H. and Kim, K. (2002). Opportunity and Inequality: Educational Stratification in Korea. *Korean Journal of Sociology* 36(4): 193-222 (in Korean).

Power, D. and Xie, Y. (2000). *Statistical Methods for Categorical Data Analysis*. San Diego: Academic Press.

Prais, S.J. (1955). The Formal Theory of Social Mobility. *Population Studies* 9(1): 72-81. doi:10.2307/2172343.

Preston, S.H. and Campbell, C. (1993). Differential fertility and the distribution of traits: The case of IQ. *American Journal of Sociology* 98(5): 997-1019. doi:10.1086/230135.

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

Raftery, A. and Hout, M. (1993). Maximally Maintained Inequality: Expansion, Reform, and Opportunity in Irish Education, 1921 – 75. *Sociology of Education* 66(1): 41-62. doi:10.2307/2112784.

Rogers, A. (1995). *Multiregional Demography: Principles, Methods, and Extensions*. New York: John Wiley and Sons.

Shavit, Y. and Blossfeld, H. (eds.). (1993). *Persistent Inequality*. Boulder: Westview Press.

Simkus, A. (1984). Structural Transformation and Social Mobility: Hungary 1938-1973. *American Sociological Review* 49(3): 291-307. doi:10.2307/2095275.

Sobel, M., Hout, M., and Duncan, O.D. (1985). Exchange, Structure, and Symmetry in Occupational Mobility. *American Journal of Sociology* 91(2): 359-372. doi:10.1086/228281.

Appendices

Table A-1: Age-specific fertility rates and survival probability, 1980–2005*

Year	Age	Births per 1,000 women			5-year survival probability**		
		Primary	Secondary	Tertiary	Primary	Secondary	Tertiary
1980	15–19	75.5	8.3	0.3	0.992	0.992	0.992
	20–24	214.7	116.4	75.7	0.991	0.991	0.991
	25–29	243.8	237.5	240.4	0.978	0.995	0.996
	30–34	115.4	113.8	117.2	0.966	0.994	0.995
	35–39	44.0	39.0	31.5	0.976	0.991	0.994
	40–44	16.8	13.2	9.6	0.961	0.988	0.992
	TFR	3551	2641	2373.5			
1985	15–19	112.3	8.9	0.6	0.995	0.995	0.995
	20–24	188.4	132.6	32.0	0.994	0.994	0.994
	25–29	113.5	160.9	177.0	0.981	0.996	0.997
	30–34	27.6	40.5	64.0	0.972	0.995	0.996
	35–39	8.0	8.7	10.3	0.976	0.992	0.994
	40–44	2.2	2.3	1.9	0.964	0.988	0.992
	TFR	2260	1769.5	1429			
1990	15–19	66.2	6.2	0.1	0.996	0.996	0.996
	20–24	124.9	85.2	57.7	0.996	0.996	0.996
	25–29	78.2	161.2	194.1	0.982	0.996	0.998
	30–34	20.3	46.5	93.3	0.973	0.995	0.997
	35–39	4.9	9.4	17.4	0.981	0.993	0.996
	40–44	1.1	1.7	2.0	0.966	0.989	0.993
	TFR	1478	1551	1823			
1995	15–19	41.1	8.9	0.1	0.997	0.997	0.997
	20–24	114.2	99.0	18.3	0.997	0.997	0.997
	25–29	122.2	199.5	167.7	0.975	0.996	0.998
	30–34	42.3	64.7	97.3	0.966	0.995	0.997
	35–39	9.9	14.3	21.5	0.981	0.994	0.997
	40–44	1.6	2.3	3.1	0.972	0.991	0.995
	TFR	1656.5	1943.5	1540			
2000	15–19	42.4	9.8	0.1	0.998	0.998	0.998
	20–24	70.9	85.3	14.3	0.998	0.998	0.998
	25–29	90.1	182.7	137.3	0.970	0.997	0.998
	30–34	46.4	80.3	111.3	0.960	0.995	0.998
	35–39	11.8	16.0	24.4	0.981	0.994	0.997
	40–44	1.7	2.5	3.9	0.972	0.992	0.996
	TFR	1316.5	1883	1456.5			
2005	15–19	32.0	5.3	0.1	0.998	0.998	0.998
	20–24	61.8	50.9	7.5	0.998	0.998	0.998
	25–29	50.2	118.0	85.7	0.970	0.997	0.998
	30–34	39.7	71.8	103.1	0.963	0.996	0.998
	35–39	13.2	16.8	25.0	0.984	0.995	0.998
	40–44	2.1	2.3	3.3	0.977	0.993	0.997
	TFR	995	1325.5	1123.5			

Notes: * Sources: Korean Census (1980–2005), Vital Statistics (1980–2005), Kim (2002).
** Survival probabilities for women aged 0–14 are not shown. For women aged 0–24, no mortality differentials are assumed.

Table A-2: Educational distribution of Korean women aged 15–44 (1980–2005) (percent)

Year	Primary	Secondary	Tertiary
1980	36.5	55.3	8.2
1985	21.1	67.1	11.8
1990	11.9	69.6	18.5
1995	5.9	62.3	31.8
2000	3.5	54.2	42.3
2005	1.4	44.8	53.8
aged 20–24 in 2005	0.3	24.6	75.1

Sources: Korean Census, 1980–2005.

Table A-3: Trends in odds ratios

Mother's education	Daughter's education	1950s	1960s	1970s	Overall
P vs. S	P vs. S	6.46	50.53	2.21	11.83
	S vs. T	5.79	4.14	3.01	5.75
	P vs. T	37.41	209.38	6.66	68.08
S vs. T	P vs. S	0.75	0.06	0.22	0.33
	S vs. T	10.27	2.74	9.97	5.74
	P vs. T	7.71	0.16	2.17	1.87
P vs. T	P vs. S	4.85	3.00	0.48	3.85
	S vs. T	59.50	11.37	30.06	33.01
	P vs. T	288.62	34.14	14.46	127.03

Sources: The Korean Labor and Income Panel Study (KLIPS), 2001–2006.
Notes: P: Primary, S: Secondary, T: Tertiary.

Table A-4: Parameter estimates of uniform association model and model comparison (BIC), N=1,489

Parameter estimates (Uniform association model)				
Variable	**Coefficients (b)**	**s.e.**	**z**	**exp(b)**
Mother's education				
primary (reference)				
Secondary	–2.762	1.037	–2.66	0.063
Tertiary	–8.347	2.233	–3.74	0.000
Daughter's education				
primary (reference)				
Secondary	2.537	1.344	1.89	12.640
Tertiary	1.166	1.638	0.71	3.210
Uniform association	1.190	0.394	3.02	3.287
Intercept	–1.859	1.302	–1.43	0.156
Model comparison (BIC)				
Saturated		0		
Uniform association		–13.397		
Row effects		–9.141		

Source: The Korean Labor and Income Panel Study (KLIPS), 2001–2006.