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Robert D. Mare
Vida Maralani

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Robert D. Mare and Vida Maralani

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*Address correspondence to Robert D. Mare, Department of Sociology, University of California, Los Angeles, CA 90095 (mare@ucla.edu). Earlier versions of this paper were presented at the meetings of the Research Committee on Social Stratification of the International Sociological Association in Tokyo in March 2003; the conference on "Frontiers of Socioeconomic Mobility: Conceptual and Methodological Challenges" in Ithaca, NY in March 2003; and the meetings of the Population Association of America in Minneapolis, MN in May 2003. We are grateful to Elizabeth Frankenberg, Judith Seltzer, and Elizabeth Bruch for advice at various stages of this research. We also benefited from the comments of participants in workshops at Northwestern University, Nuffield College, and the University of Wisconsin-Madison. This research was supported by the John D. and Catherine T. MacArthur Foundation and the Russell Sage Foundation. The authors used the facilities of the California Center for Population Research, which is supported by the National Institute of Child Health and Human Development.

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ABSTRACT

The effect of the socioeconomic characteristics in one generation on the socioeconomic achievement of the next generation is the central concern of social stratification research. Researchers typically address this issue by analyzing the associations between the characteristics of parents and offspring. This approach, however, focuses on observed parent-offspring pairs and ignores that changes in the socioeconomic characteristics of one generation may alter the numbers and types of intergenerational family relationships that are created in the next one. Models of intergenerational effects that include marriage and fertility, as well as the intergenerational transmission of socioeconomic status, yield a richer account of intergenerational effects at both the family and population levels. When applied to a large sample of Indonesian women and their families, these models show that the effects of women's educational attainment on the educational attainments of the next generation are positive. However, the beneficial effects of increases in women's schooling on the educational attainment of their children are partially offset at the population level by a reduction in the overall number of children that a more educated population of women bears.

HOW DO WOMEN'S EDUCATIONAL ATTAINMENTS AFFECT THE EDUCATIONAL ATTAINMENT OF THE NEXT GENERATION?

INTRODUCTION

The study of intergenerational social mobility is centrally concerned with estimating the effects of the positions, statuses, and resources of a family on persons born and raised in the family. These effects show who gets ahead in a society and the benefits to children of improvements in their parents' socioeconomic positions, and cast light on the persistence of social hierarchies, the rigidity of stratification, and mechanisms of social change. For example, in a developing society, it is important to know the possible effects of parents' educational attainment on the education and general well-being of their children. These effects not only show the pattern of inequality of educational opportunity within the society and but also may point the way towards improving the lives of children through efforts to improve the education and socioeconomic level of their parents.

Social background effects and social mobility, and their variations across time, place, and dimensions of socioeconomic inequality are extensively documented (e.g., Erickson and Goldthorpe 1992; Featherman and Hauser 1978; Hout 1988; Mare 1981; Shavit and Blossfeld 1993; Treiman and Ganzeboom 1999). Yet whereas many analysts of intergenerational processes estimate the associations between the socioeconomic characteristics of parents and offspring (for example, the association between the educational attainment of parents and the educational attainment of their sons and daughters), it is often unclear whether parents' characteristics are in fact *causes* of the characteristics of their offspring. Researchers use multivariate models to isolate the net effects of parents' socioeconomic statuses to control as many confounding variables as possible. But this is often insufficient to establish that a change in the socioeconomic characteristics of parents would necessarily lead to a change in their children's achievement. Unmeasured factors confound observed associations between parents' and offsprings' characteristics that might otherwise have a causal interpretation (e.g., Sobel 1998; Behrman and Rosenzweig 2002). Efforts to improve the life chances of offspring by raising the educational attainments of mothers, for example, may be fruitless if the apparent "effect" of mother's educational attainment on the schooling of children is the spurious result of unobserved links between parents and offspring (such as genetic or marriage market sorting effects).

The interpretation of social background effects, however, depends not only on controlling for confounding factors, but also on specifying the mechanisms through which intergenerational effects may occur. Although the problems created by "omitted variables" in the analysis of intergenerational effects are widely appreciated, almost all discussions of intergenerational mobility give an inadequate account of how generations of men and women affect the socioeconomic attainment of subsequent generations. Even if the unobserved, confounding causes of socioeconomic attainment were fully controlled, causal inference would depend on understanding the mechanisms through which one generation affects the next. To see how parents' characteristics affect those of their offspring, it must be possible, in principle, to change those characteristics to yield an outcome different from what would otherwise occur. But conventional mobility studies are ill-suited for assessing the effects of this type of intervention because these analyses typically focus on relationships between parents and offspring *conditional on existing mother-father and parent-child relationships*, rather than on the *unconditional relationships between parent and offspring generations.* The study of observed family relationships fails to account adequately for the impact of the intervention on the formation of families. Existing mother-father or parent-child pairs are conditional on previous marital and fertility choices. Unconditional effects, however, include the effects of the intervention on marital and fertility choices as well. Thus, even if random assignment of children to families were somehow achieved, the resulting inferences from otherwise conventional approaches to the study of intergenerational relationships may still be of questionable value for practical and theoretical questions about the impact of family background on the next generation. Even in descriptive studies of intergenerational relationships, conventional approaches yield incomplete results. A more encompassing social and demographic model that reveals the unconditional relationships between the characteristics of successive generations is needed for either causal inference or adequate description.

In this paper we argue that most mobility studies are inadequate for assessing the intergenerational impact of socioeconomic characteristics. We propose alternative models that provide improved estimates of intergenerational effects. To elucidate these ideas and models we focus on the effects of women's educational attainments on the education of the subsequent generation. We show how to estimate the unconditional effects of interventions to raise the schooling of women in the maternal generation and how these effects work through marriage, fertility, and intergenerational transmission. This enables us to go beyond the standard approach, which is to estimate effects of mothers' schooling conditional upon the existence of mother-child pairs.

In the next section of the paper we argue that the assessment of the effects of women's schooling on the educational attainment of subsequent generations requires that one focus on differential fertility and marriage, in addition to the relationship between mother's and children's educational attainment. The unconditional relationship between the educational attainments of successive generations is the mechanism through which the intergenerational effects of efforts to raise the educational attainments of women are likely to occur. In subsequent sections, we briefly review educational and demographic patterns in Indonesia, an interesting population in which to study the effects of changing women's educational attainments, We present our models of intergenerational effects, describe the Indonesian Family Life Survey (which we use to estimate our models of intergenerational effects), and discus our estimation and simulation methods. Then we present our empirical results, including simulations of the intergenerational effects of hypothetical interventions to raise educational attainment in the maternal generation and comparisons with more conventional estimates of family background effects. Finally, we summarize our main findings and conclusions.

CONDITIONAL AND UNCONDITIONAL INTERGENERATIONAL EFFECTS: WOMEN'S EDUCATIONAL ATTAINMENTS

The intergenerational effects of changes in the socioeconomic characteristic of adults occur partly through individual and family level variables that intervene between those characteristics and the characteristics of the offspring generation (e.g., Blau and Duncan 1967; Jencks *et al.* 1972; 1979). For example, research on socioeconomic attainment and the transition to adulthood has focused on the role of social psychological factors (e.g., Sewell, Hauser, and Portes 1969), family size (Blau and Duncan 1967; Blake 1989), family structure (Duncan and Duncan 1969; McLanahan and Sandefur 1994), the childrearing behavior of parents (McLanahan and Astone 1991), and families' strategic responses to incentives (Breen and Goldthorpe 1997) in efforts to show how families transmit their unequal positions, statuses, and resources to subsequent generations. Throughout this rich body of intergenerational research, these mechanisms are inferred from observations on the characteristics of parents and children in existing families. By themselves, these are *conditional* effects in that they depend on existing mother-father and parent-child relationships. In the study of intergenerational occupational mobility, for example, researchers typically focus on the associations between the occupational classifications of fathers and sons. These are conditional relationships in that they are based on observed father-son pairings in the population. Intergenerational effects, however, may also occur through mechanisms that alter the numbers and types of families in which children are raised. If changing people's characteristics alters their propensity to marry, the types of persons they marry, how long they live, or the number of their children who survive to adulthood, these mechanisms also will alter the distribution of socioeconomic outcomes in subsequent generations. These full effects, however, cannot be inferred from existing mother-father and parent-child relationships alone. The unconditional effects of changes in adult socioeconomic characteristics include the effects of marriage, fertility, and mortality, in addition to the effects of parents on children conditional on marriage and the birth and survival of a child. Unconditional effects require that one consider both family-level and aggregate processes that govern the reproduction of inequality from one generation to the next.

The Effects of a Change in Women's Educational Attainment

Although our argument applies to all aspects of family background that may affect the life circumstances of the next generation, we focus here on the effects of women's educational attainments on the educational attainments of subsequent generations. Mother's schooling is often viewed as a key determinant of the welfare of her children. In populations with low average maternal educational attainment or a large gap in education between men and women, it may be possible to improve the lives of both women and their children by removing barriers to their advancement in school (e.g., Caldwell 1986; King and Hill 1993; Schultz 2001; Summers 1994).[1]

Consider the effect of a mother's educational attainment on the attainment of her daughter or son. If a mother's attainment is a cause of her child's attainment, then one may ask: what is the effect on children of a policy that changes the schooling of an individual woman, of an entire cohort of women, or some targeted subgroup of women? This question raises important research design issues. Regression estimates based on samples of offspring, which are the most common tool for answering this type of question, can at best show the impact of changing a woman's attainment level conditional upon her giving birth to the sampled child and, if father's or other family characteristics are controlled in the analysis, upon her marriage. Even if all important confounding factors are controlled, these conditional estimates may be quite unsatisfactory for many purposes, including attempts to assess the effects of interventions in women's lives on subsequent generations. Women complete most of their schooling prior to childbearing and, in most societies, prior to marrying the fathers of their children. A change in a woman's educational attainment may alter whether, when, and whom she marries; the number and timing of the children she bears; how many of these children survive to adulthood; and the educational attainment of her surviving children. Thus, the estimate of the impact of mother's education depends on whether it is assumed that she has already given birth, has not yet given birth but has formed a union with a child's (potential) father, or has not yet taken a partner.

It is impossible to discern the full impact of changing a woman's educational attainment by observing a sample of existing families. At the individual level, marriage and fertility are intervening mechanisms between a woman's educational attainment and the attainment of her children. At the population level, the impact of a change in the average level or the distribution of women's schooling must take full account of both the intergenerational correlation of educational attainments and also the population renewal process. These processes alter the relative numbers of children who achieve various levels of educational attainment. For a given distribution of women's educational attainment and conditional effects of mothers on children, the resulting distribution of offspring's schooling may differ between populations that have different patterns of differential fertility by mother's educational attainment. Thus, to assess the impact of a change in women's schooling in the parents' generation on the distribution of education in a later generation, it is necessary to examine its separate effects on marriage, childbearing, and the educational attainment of children.

In addition to fertility and marriage, differences among women in the timing of fertility, their rate of marital disruption, their rate of survival through the childbearing years, and their children's rate of survival to adulthood are also potentially important demographic factors that contribute to intergenerational reproduction. These mechanisms often depend on women's schooling as well, and are a part of the full accounting of the intergenerational effect of women's educational attainment. In most societies, however, the fertility and marriage processes emphasized in this paper are likely to be the most important demographic mechanisms governing the intergenerational impact of women's schooling. We return to these additional processes later in the paper.

Differential Fertility

An association between women's educational attainment and their levels of fertility is observed in virtually all societies (e.g., Bledsoe *et al.* 1999). The most prevalent relationship is a negative correlation, typically interpreted as arising from the delays in marriage, improved economic opportunities in the labor market, ability to acquire information about contraception, and freedom from traditional women's childbearing roles that come with increased formal schooling. Yet the strength and even the form of this relationship vary considerably across societies and over time. Some societies exhibit positive associations between women's educational attainment and their children ever born and others have a curvilinear pattern in which women with some primary schooling have higher fertility than those who have either no education or secondary and tertiary schooling (Diamond, Newby, and Varle 1999; Jeejeebhoy 1995). These alternative patterns may reflect relatively low levels of family resources, or poor health or marriage prospects for women with very low levels of educational attainment.

For a given pattern of differential fertility, the impact of a change in the distribution of women's educational attainments occurs at two levels, the family level and the population level. For children within a family, variation in their mother's level of fertility may affect their well being and eventual socioeconomic attainment because of the differential advantages and disadvantages associated with variations in number of siblings. In most developed and low fertility societies, children's attainments typically vary inversely with number of siblings, a result of either the more severe resource constraints experienced by larger families (Blake 1985) or the tradeoffs that parents make between larger families with relatively lower social, economic, and cultural resources for each child or smaller families with relative higher resources for each child (Becker 1991). In less developed and higher fertility societies, the relationships between sibship size and children's achievements are varied. Although a large number of children may limit the resources available to a child, they may also enhance family wealth and provide access to broader social networks for children. As a result the association between sibship size and children's schooling may be weak or even positive in these contexts. Shavit and Pierce (1991), Lloyd (1994), and Maralani (2004) provide extensive illustrations of these relationships. Whatever the context, a change in a woman's educational attainment may affect the educational attainment of her offspring because it may change her eventual fertility, her children's number of siblings, and the family resources available to each child.

The effects of fertility discussed thus far concern the family-level associations between the characteristics of a mother, her number of children, and the welfare of her children. Differential fertility, however, also affects changes at the population level by altering the *numbers* as well as the characteristics of male-female and mother-child relationships. Within a population, the effect of a change in the distribution of women's education on the educational attainment of the next generation may depend on whether it increases the relative numbers of children born to highly or less educated women. If fertility and educational attainment are negatively correlated, the beneficial effect on the next generation of an increase in average education of women will be dampened by the tendency of more educated women to have fewer children than their less educated counterparts.[2] Thus, whereas an improvement in women's average educational attainment may benefit whatever children they bear, they may bear fewer children overall. This implies that the individual and population level effects of an improvement in women's schooling may be offsetting. In contrast, if the relationship between education and fertility is curvilinear, the size of the effect of an increase women's educational attainment will depend on where in the education distribution changes occur. For example, if fertility is highest for women with an intermediate level of education, efforts to raise the education level of women at the bottom of the education distribution may have a twofold benefit for the next generation: On average, mothers will be more educated *and* they will bear more children. In contrast, efforts to move women from an intermediate to the highest level of education may again, as in the case of an overall negative association between women's education and fertility, have offsetting effects at the individual and population levels. In short, differential fertility among women with varying educational attainments may lead to a mixture of individual or family effects that are conditional on existing family relationships and unconditional population-level effects that work through relative numbers of different family sizes. A full assessment of family background effects must take both of these types of effects into account.

A woman's educational attainment may affect the timing as well as the level of her fertility. For individual children, this may affect their attainment because children born later in their mothers' lives tend to go further in school than children born to young mothers, *ceteris paribus* (Mare and Tzeng 1989). For the population this may alter the education distribution of subsequent generations by modifying the relative growth rates of the offspring of different education classes of mothers. Early fertility results in more rapid population growth than later fertility (e.g., Keyfitz 1985). Thus, an overall increase in women's educational attainment would benefit the offspring of these women, but the delay in fertility that would likely accompany this increase would slow the rate of population growth and change, even if the average fertility of women were unchanged. This effect, however, is almost always much smaller than the fertility level effect on population growth and may be muted further in populations with high levels of intergenerational educational mobility (Mare 1997).[3]

Marriage, Marriage Timing, and Assortative Mating

Marriage also affects the educational reproduction process in several ways. For individual families, mother's marital status and father's educational attainment affect the educational attainment of offspring. For an individual woman, a change in her characteristics may alter her opportunities and incentives for the timing of her marriage, the type of partner she marries, and the stability of her marriage. An increase in her attainment will typically raise the educational attainment of the man she marries and provide additional advantages to the children born to the couple.

At the population level, marriage alters the education distribution of the next generation both directly through the changes in the joint distribution of mothers' and fathers' characteristics and their effects on the attainments of offspring, and indirectly through its effect on levels and differentials in fertility. An aggregate improvement in women's educational attainment may directly affect the next generation by altering the joint distribution of mothers' and father's educational attainments. The size and direction of this effect, however, depends on the organization of the marriage market and how men respond to aggregate improvements in women's educational status. On the one hand, if improvements in women's educational attainments induce men to stay in school longer as well, then the association between husband's and wife's schooling is unlikely to change. Both fathers and mothers will be more educated on average and the offspring generation will benefit from average improvements in both parents' educational attainments. On the other hand, improvements in women's educational attainments may not be matched fully by corresponding improvements for men if women benefit from targeted government subsidies or experience other improvements in their lives that are not enjoyed by men. In this case, the association between wife's and husband's educational attainments may change because, at any given level of educational attainment, women may partner with men who have somewhat lower average attainment than would have been available in the absence of increases in the numbers of more highly educated women. Thus, the resulting change in the joint distribution of mothers' and father's schooling, as well as their impact on the educational attainments of their offspring will depend on the shape of the educational distribution of men and where in the distribution of women's educational attainments the greatest changes occur.

The aggregate effect of marriage also affects the next generation through fertility. For example, if nonmarital fertility is negligible and highly educated women are relatively more likely to remain single or marry later, an increase in women's schooling will reduce fertility and dampen the aggregate benefit for the next generation. Similarly, patterns of educational resemblance between women and their husbands may modify differential fertility patterns in a complex way, depending on the pattern of differential fertility among couples with varying levels of wives' and husbands' schooling. If the educational attainments of wives and husbands are strongly associated, an increase in women's average attainment may enhance or suppress the effects of women's educational differentials in fertility, depending on how the attainments of wives and husbands jointly affect numbers and timing of children ever born.

Improvements in the status of women potentially affect the next generation through a complex mixture of effects at the individual, family, and population levels. These effects may either offset or amplify one another. Neither their directions nor their magnitudes can be known from standard analytic approaches that are based on associations among variables at the individual or family levels. Rather, it is necessary to analyze these relationships in the context of a model of population reproduction.

Related Literature

Our effort to embed intergenerational mobility in a demographic model that also includes fertility and marriage builds upon prior research. Over the past 50 years, researchers have attempted to examine the implications of differential fertility for the study of social mobility and, conversely, attempted to incorporate intergenerational and assortative mating into the study differential population growth. Mukerjee (1954) and Duncan (1966) criticized naïve efforts to use the analysis of intergenerational social mobility as a tool for projection of occupation and other socioeconomic distributions when the differential fertility of socioeconomic groups is ignored. Subsequently, researchers have developed models that combine intergenerational mobility, fertility, and marriage for the analysis of changes in occupation distributions (Matras 1961, 1967; Preston 1974), income inequality (Lam 1986), religious affiliation (Johnson 1980), intelligence (Preston and Campbell 1993), the distribution of educational attainment (Mare 1997, 2000), and poverty and family structure (Musick and Mare [forthcoming]. The approach discussed in this paper extends this prior research by using a model of socioeconomic and demographic reproduction to develop new methods of estimating the *effects* of family socioeconomic background on educational attainment. That taking account of marriage and fertility may alter one's assessment of intergenerational effects is only implicit in these prior studies. By modeling these processes explicitly, we link standard sociological efforts to determine the effects of family background on achievement with formal demographic studies of intergenerational processes.

WOMEN'S EDUCATION EFFECTS IN INDONESIA

We investigate these issues and illustrate alternative estimates of the intergenerational effects of women's educational attainment using data for Indonesia. We rely on the Indonesian Family Life Survey (IFLS), which we discuss in Section 5. Indonesia has the world's fourth largest population and is the largest predominantly Muslim nation. Most important for our work, average levels of educational attainment among Indonesian women are low relative to most North American and European nations, although they have increased markedly among recent cohorts of young women.

Indonesia has also undergone huge demographic changes during the past 30 years, including massive declines in fertility and mortality rates and substantial rural to urban migration. Total fertility has declined markedly during the past 30 years, dropping from 5.6 children per woman in 1971 to 2.6 children in 1999 (Badan Pusat Statistik, Republik Indonesia

2004). Despite the fertility decline, marriage remains nearly universal among Indonesian women. For example, in 1980, 78 percent of 20-24 year olds, 94 percent of 25-29 year olds, and 97 percent of 30-34 year old women were married (Hirschman and Guest 1990).

During this period, average educational attainment levels and sex differentials in education have changed dramatically as well. For example, among men born in 1930-34, 27 percent had no formal schooling and 92 percent had no more than primary school. For women in this cohort 56 percent had no formal schooling at all and 97 percent had no more than primary school. For men born in 1960-64 in contrast, only 5 percent had no formal schooling and 36 percent had more than primary schooling. For women, these corresponding percentages were 10 and 23 percent respectively (Cobbe and Boediono 1993). More recent cohorts show still higher levels of educational attainment and smaller differences between men and women.

Fertility in Indonesia varies by women's educational attainment, although it does not follow a simple inverse relationship. Among Indonesian women in the 1970s, fertility was highest for women with primary education, lowest for the small proportion of women with post-secondary schooling, and at an intermediate level for women with no schooling or secondary schooling (Hirschman and Guest 1990). This curvilinear pattern has persisted in more recent years, albeit in a somewhat attenuated form, as shown by our calculations discussed in Section 5.

Although the arguments and models discussed in this paper are adaptable to any population, Indonesia is a good context for this research. Its comparatively low levels of educational attainment and large gender gap in attainment make it a realistic setting for considering the effects of hypothetical interventions to raise the educational attainment of women and improve the life chances of their children. Its near universal marriage, moderate mortality, and low nonmarital fertility make the relatively simple models of intergenerational effects considered in this paper more realistic for this population than for populations with either very high parental mortality during the childbearing years or high nonmarital fertility.

MODELS FOR THE INTERGENERATIONAL EFFECTS OF WOMEN'S EDUCATIONAL ATTAINMENTS

We focus on how a population of women with varying amounts of schooling produces a generation of offspring who also vary in their educational attainment, taking account of three processes: (1) marriage, focusing on whom women of varying education levels are likely to marry; (2) differential fertility, as affected by mother's and father's education; and (3) the intergenerational transmission of educational status. Most research on intergenerational mobility is exclusively focused on (3), but (1) and (2) are essential parts of the reproduction process as well.

In the following discussion, we assume that all women marry; ignore mortality of women and children, the timing of fertility and marriage, and the instability of marriage; and assume that everything happens all at once for a given cohort or, equivalently, a generation at a time. That unmarried women bear and raise children is obviously true in general, but occurs at such a low rate in Indonesia that is it safely ignored in this context. We also ignore differential mortality of women and children. These assumptions are in keeping with most standard analyses of intergenerational mobility and socioeconomic attainment, although these aspects of the process could be incorporated into the model discussed here. The model provides a way of assessing the contribution of women and mothers to the reproduction of the population, but allows assortative marriage to affect fertility and intergenerational transmission. It is not a two-sex model because the marriage market is female-dominated. For the purpose of estimating the model we assume that whatever kind of man a woman or her family wants (at least, with respect to his education), she can get. As discussed below, however, in estimating the effects of a change in the distribution of women's schooling, we explore the implications of alternative assumptions about how the distribution of men's educational attainments changes in response to improvements in women's status.[4]

Let D_j be the number of persons in the offspring generation with education level j, M_i be the number of women in the mother generation with education level i, and r_{ijk} be the number of children who attain education level j per woman who has attained education level i, and has a husband with education level k. The r_{ijk}, therefore, are the rates at which men and women at given levels of educational attainment produce children who attain given levels of attainment. These rates incorporate the effects of marriage, fertility, and intergenerational transmission on intergenerational reproduction. Let $i = 1, \ldots, 5$; $j = 1, \ldots, 5$, $k = 1, \ldots, 5$. Thus, education has five discrete, but ordered levels. Then:

$$(1) \qquad D_j = \sum_{i=1}^{5} \sum_{k=1}^{5} r_{ijk} M_i \ .$$

Given the r_{ijk} we can compute the expected number of children of education level j born to a mother with education level i. If the processes governing the r_{ijk} are time-invariant, and we know the education distribution of women at a given date, then this equation can project the education distribution of women for successive generations. We can also simulate what would happen to D_j if the distribution of M_i were modified.

We can express how marriage, fertility, and intergenerational transmission affect the r_{ijk} as follows:

$$(2) \qquad r_{ijk} = p^{H}_{k|i} r_{ik} p^{D}_{j|ik} \ ,$$

where $p^{D}_{j|ik}$ denotes the probability that a child with a mother at the i^{th} education level and a father at the k^{th} education level will attain the j^{th} level of education, r_{ik} is the expected number of children born to women in the i^{th} education category who are married to men in the k^{th} education category, and $p^H_{k|i}$ is the probability that a woman in the i^{th} education category marries a man in the k^{th} education category.[5]

The child attainment probabilities $p^D_{j|ik}$ can be expressed as an ordered logit model in which the covariates include mother's and father's educational attainments:

$$(3) \qquad p^D_{j|ik} = \frac{\exp(\kappa_j - \alpha^W_i + \alpha^H_k)}{1+\exp(\kappa_j - \alpha^W_i + \alpha^H_k)} - \frac{\exp(\kappa_{j-1} - \alpha^W_i + \alpha^H_k)}{1+\exp(\kappa_{j-1} - \alpha^W_i + \alpha^H_k)},$$

where the κ_j denote the cutpoints of the cumulative distribution of offspring's education (with $\kappa_1 = -\infty$ and $\kappa_5 = \infty$) (e.g., Long 1997).[6] In the empirical implementation of this model, we also consider versions of this model that include sex of child, interaction between child's sex and parents' educational attainments, and number of siblings as independent variables. The specific form of the model that we use is discussed more fully below.

The fertility rates r_{ik} can be expressed as an event count model (poisson or negative binomial) for fertility (e.g., Long 1997), in which the covariates include mother's and father's educational attainment:

$$(4) \qquad \log(r_{ik}) = \beta + \beta^W_i + \beta^H_k + \beta^{WH}_{ik}.$$

The marriage probabilities $p^H_{k|i}$ can be expressed as an ordered logit model in which the covariates include categories of women's educational attainment:

$$(5) \qquad p^H_{k|i} = \frac{\exp(\rho_k - \gamma^W_i)}{1+\exp(\rho_k - \gamma^W_i)} - \frac{\exp(\rho_{k-1} - \gamma^W_i)}{1+\exp(\rho_{k-1} - \gamma^W_i)}$$

where the ρ_j are the cutpoints of the cumulative distribution of husband's education (with $\rho_1 = -\infty$ and $\rho_5 = \infty$).[7]

These models are recursive in that mother's schooling precedes marriage and father's schooling, which precedes fertility, which precedes offspring's schooling. It is possible to estimate each of the three equations separately. The marriage equation requires only a cross classification of adult women's education, their marital status, and the educational attainment of their husbands. The fertility equation requires a table of completed fertility rates specific to mother's and father's educational attainment and mother's marital status. The transmission equation requires a cross classification of offspring's educational attainment by mother's and father's educational attainment.[8]

DATA AND METHODS

Indonesian Family Life Survey

Our analyses are based on the Indonesian Family Life Survey (IFLS), a longitudinal household sample first interviewed in 1993 (IFLS1) and followed up in 1997 (IFLS2), 1998 (IFLS2+), and 2000 (IFLS3) (RAND 2003). The IFLS is a comprehensive socioeconomic and health survey, containing detailed information on demographic and socioeconomic characteristics, household economy, health, fertility and marriage histories, and child cognitive and health assessments. Almost everyone in the household was interviewed directly so the data are both comprehensive and largely self-reported. When necessary, the survey also collected information by proxy. The survey represents an area that includes 13 of Indonesia's 26 provinces and 83 percent of its population. We use the public domain data from the 1993 and 1997 waves. The surveys achieved very high response and follow up rates: 93 percent of the sampled households were successfully interviewed 1993 and 94 percent of the households interviewed in 1993 were relocated and reinterviewed in 1997.

The 1993 data consist of interviews with selected members of 7224 sampled households, including all household heads and their spouses, two randomly selected children between the ages of 0 and 14, a randomly selected remaining individual age 50 or older and her/his spouse, and, for 25 percent of households, a randomly selected remaining individual between the ages of 15 and 49 and her/his spouse. The IFLS2 survey reinterviewed all surviving respondents to IFLS1 plus all members of IFLS1 households who were born before 1968. The combination of the 1993 and 1997 data provides a near complete enumeration of 1993 household members. This combined sample also provides a more adequate sample of persons who were not household heads, spouses of heads, or children of heads than the 1993 survey. The 1997 survey followed IFLS1 household members who formed new households and included their spouses and children as well. To maintain approximately representative samples, we excluded new household members in the 1997 survey who were not members of the households sampled in 1993. For detailed IFLS documentation, see Frankenberg and Karoly (1995) and Frankenberg and Thomas (2000).

Our analytic samples include ever-married female respondents ages 41 and older in 1997 and their adult children. For 1993 respondents not interviewed in 1997 (either because they died between the two waves or because the 1993 household was not located in 1997), we use information from 1993 whenever possible to retain these cases in our sample. For each ever-married woman, we assemble a full count of all live births, the schooling level of each living child age 20 and older, and the schooling of her husband (either current or previous). Only observations with complete data on woman’s, husband’s, and children’s schooling and woman’s age, marital status and fertility are included. Our samples of women and children are restricted in age to capture completed fertility and completed schooling. Our analyses use two interdependent samples of IFLS women and their offspring described below.

Husband's Education/Fertility Sample. This sample includes 3,938 ever-married female respondents ages 41 and over. These observations are used for assessing the effects of women's educational attainment on the educational attainment of the men whom they married and their number of children ever born. For the approximately 20 percent of ever-married female respondents who married more than once, we use the educational attainment of the husband to whom she was married for the longest period between her ages 15 and 40. When weighted, this sample is approximately representative of ever-married Indonesian women ages 37 and over in the target sample areas of the IFLS in 1993.[9]

Intergenerational Transmission Sample. This sample includes 10,820 offspring aged 20 and over of ever-married female respondents ages 41 and over. Many but not all off these offspring were themselves IFLS respondents. The offspring have a median age of 30 years, with an interquartile range from 25 to 36 years. The mothers of these sampled children are a subsample of the women included in the husband's education/fertility sample described above, namely those who had at least one surviving child aged 20 or older with valid information on the necessary variables. This corresponds to 3,236 of the 3,938 women included in the husband's education/fertility sample described above. Women with more than one eligible child contribute multiple observations to this offspring sample. When weighted, this sample is approximately representative of the offspring aged 20 and over of ever-married women in the target sample areas of Indonesia in 1993.

For each respondent the IFLS asks the highest level of school attended (no school, elementary, junior secondary, senior secondary, post secondary) and the highest grade or number of years completed at that level. Taking account of sample size constraints, we collapse this information into highest level of school attempted and use the five school levels listed above as our measure of schooling. Table 1 summarizes the education distributions of women, husbands, and children for each of the relevant samples. These distributions show the sizable education differences by gender and a substantial intergenerational increase in educational attainment between parents and their adult children. At the extremes of the education distribution, nearly half of the mothers in our sample had no formal schooling and less than two percent achieved any post secondary education. In contrast, less than one third of husbands had no formal schooling whereas more than twice as many husbands as wives had post secondary schooling. The children of these parents achieved much higher levels of educational attainment: only 6 percent of adult male children and 11 percent of adult female children failed to attend any school while 11 and 8 percent, respectively, went beyond secondary school. Although the gender gap in schooling was still present in the sample of adult children, differences in schooling by sex diminished greatly from one generation to the next.

Table 2 summarizes the distributions of the three outcome variables by women's educational attainment estimated from the relevant samples used in our analyses. The distribution of husband's educational attainment shows strong positive assortative mating on formal schooling in Indonesia, with a pronounced tendency for a woman to marry a man who is at the same or next level of schooling higher than she is. The fertility distribution reflects the well-known curvilinear pattern of fertility by mother's educational attainment. The distribution of offspring's education shows a strong positive association between mother's and offspring's schooling but also substantial upward intergenerational educational mobility.

Estimation and Simulation

We estimate equations (3) – (5) by maximum likelihood, applied to each equation separately. We use the parameter estimates from our models to compute the expected distributions of offspring's schooling that are implied by alternative assumptions about the educational attainment distributions of the mother's generation and about the ways that women's attainment affects marriage, fertility, and the attainment of children. We use predicted probabilities of a woman marrying a man at each level of educational attainment, predicted number of children born, and predicted probabilities of children achieving each level of educational attainment that are implied by parameter estimates and actual or hypothetical values of observed characteristics of women and their husbands. That is,

$$(6) \qquad \hat{r}_{ijk} = \hat{p}^{D}_{j|ik}\hat{r}_{ik}\hat{p}^{H}_{k|i},$$

where ^ denotes predicted values and all other notation is as defined above. Given the $\hat{r}_{ijk}$ for each woman in the initial generation, the expected number of persons in the offspring generation who attain the jth education level is $\hat{n}^{d}_{j} = \sum_{i} \sum_{k} \hat{r}_{ijk}$. As discussed in further detail below, the $\hat{r}_{ijk}$ are computed under a variety of scenarios that vary with (1) the hypothetical change in the education distribution of the mothers' generation, (2) the presence or absence of variation in the three components of r_{ijk} that are included in equation (6) (that is, which of the women's education effects on marriage, fertility, and child's schooling are taken into account in a simulation), and (3) alternative assumptions about the marriage market.[10]

EMPIRICAL RESULTS

Parameter Estimates

Table 3 reports parameter estimates for the three parts of our model. Figures 1-3 show the corresponding predicted education probabilities or predicted number of children for each model. All equations are restricted to married women over age 40 or their adult children. Women's, husbands', and children's schooling are measured in the five categories discussed above. In the fertility equation, the model assumes discrete, additive effects of women's and husband's schooling. We report ratios of coefficients to robust standard errors for all models. For the transmission model, we report ratios of coefficients to robust standard errors that also correct for clustering of multiple children born to the same woman. The equation for the educational attainment of offspring includes the additive effects of mother's and father's schooling plus an indicator for sex of offspring. Preliminary analyses indicated no important interactions of mother's and father's schooling in their effects on either fertility or the educational attainment of their children. The effects of father's educational attainment differed somewhat by sex of child; that is, contrasts between the children of highly and moderately educated fathers are greater for female than for male offspring. Although these differences are of interest in a detailed analysis of Indonesian educational patterns, their inclusion does not affect our estimates of the effects of changes in women's educational attainments. For the sake of simplification, therefore, we base our calculations on the additive models shown in Table 3.[11]

Indonesian couples show extremely strong evidence of positive assortative mating. The coefficients show that the odds of marrying into the next highest husband's educational category are more than seven times greater both for women with elementary schooling versus those with no schooling [exp(2.014)] and for women with junior secondary schooling versus those with elementary schooling [exp(4.072 – 2.014)]. The odds of marrying into the next highest husband's education category are about four times greater for women with senior secondary schooling than for those with junior secondary schooling [exp(5.571 – 4.072)] and for women with post secondary schooling than for those with senior secondary schooling [exp(6.94 – 5.571)]. Figure 1 shows that the percentages of women who marry men with at least a senior secondary education increases monotonically from less than two percent for women with no formal schooling to more than 90 percent for those with post secondary schooling. Given the gender gap in educational attainment in Indonesia for this generation, women tend to marry men who have more schooling than they do. For example, among women with senior secondary education, 30 percent marry men with post secondary schooling. In contrast, among women with elementary schooling, only 12 percent marry men with no schooling.

The estimates of the effects of parents' schooling on number of children ever born follow the curvilinear pattern of differential fertility found in other research on Indonesia. Holding husband's education constant at the elementary level, women's expected number of children is approximately 5.0 for women with junior secondary education or less and declines sharply across the higher education categories to 3.7 for women with post secondary education (see Figure 2). The effect of husband's education on fertility is much smaller than the effect of wife's education. Holding constant women's educational attainment, husbands with primary, secondary, or post secondary schooling all have approximately 5.3 children, whereas men at the bottom of the education distribution average somewhat fewer children.

The results in Table 3 show that the educational attainments of mothers and fathers both have strong positive effects of approximately equal size on the attainments of their children. Figure 3 shows predicted probabilities of boys' and girls' schooling by levels of mother's schooling, holding constant father's schooling. Boys' and girls' educational attainments increase substantially between each successive level of mother's attainment. For example, approximately 55 percent of male children and 65 percent of female children born to women with no education, themselves attain elementary school or less, whereas only 20 percent of males and 30 percent of females born to women with senior secondary schooling have levels of education this low. These estimates also highlight the big intergenerational increase in average educational attainment in Indonesia over the period to which these data correspond.

These results provide a partial picture of the effect of mothers' educational attainment on their offspring's attainment. In most standard analyses, the parameters of a transmission equation (predicting children's schooling from parents' schooling) are used to evaluate the effect of a hypothetical change in mother's schooling on the schooling of her children. To assess the overall effect of an increase in women's educational attainment, however, it is necessary to take account of the joint aggregate effects of marriage and fertility as well.

Simulations

We assess the effects of women's education on the educational attainment of the next generation through a series of simulations. Each simulation has three parts: (1) a hypothetical change in women's schooling, (2) whether one considers only the transmission process or the effects of marriage and/or fertility processes as well, and (3) whether men's schooling increases with expansions in women's schooling or the men's educational distribution is held fixed. We combine these parts as follows. For each simulation, we draw a random subsample of five percent of the women in the marriage/fertility sample (3938 * 0.05 = 197 women) subject to a hypothetical change in the women's education distribution that we want to consider.[12] For example, to estimate the effect of moving five percent of the sample women from no schooling to elementary schooling, we randomly draw without replacement 197 women from the no schooling category and change their schooling from none to elementary. The other 95 percent of the women retain their original values. We then use the parameters estimated from our models and the remaining assumptions that we want to examine (specifically, whether fertility and/or marriage are taken into account and the way in which men respond to changes in women's educational patterns) to predict husbands' and offspring's education distributions and the number of children born in each educational category in the subsequent generation. We then form a ratio of the simulated offspring educational distribution to the baseline distribution predicted by our sample women's observed schooling to see whether a given simulation increases or decreases the proportion of children in each schooling level (relative to making no changes in women's schooling). We describe each component of the simulations in more detail below.

Changes in Women's Education Distribution. We simulate the "effect" of women's schooling by computing the expected offspring education distribution under six scenarios for women's educational attainment:

A1. The education distribution of the sample women, as observed;

A2. Five percent of sample women are drawn from education category 1 (no schooling) and reassigned to category 2 (elementary schooling) while the remaining 95 percent retain their sample values;

A3. Five percent of sample women are drawn from education category 2 (elementary) and reassigned to category 3 (junior secondary) while the other 95 percent retain their sample values;

A4. Five percent of sample women are drawn from education category 3 (junior secondary) and reassigned to category 4 (senior secondary) while the other 95 percent retain their sample values;

A5. Five percent of sample women are drawn from education category 4 (senior secondary) and reassigned to category 5 (post secondary) while the other 95 percent retain their sample values;

A6. Five percent of sample women are drawn from education category 1 (no schooling) and reassigned to category 5 (post secondary) while the other 95 percent retain their sample values.[13]

Scenarios A2-A5 each move five percent of the sample one education level beyond their observed level. Scenario A6 moves five percent of the sample from the lowest to the highest education category. We standardize each expected education distribution to the sample average fertility level and compare it to distribution of children predicted by the observed women's education distribution represented by scenario A1.

Combinations of Effects. Each of the scenarios above is carried out for each of four combinations of processes using the components of equation (6):

B1. intergenerational transmission only;

B2. intergenerational transmission plus differential fertility;

B3. intergenerational transmission plus educational assortative mating;

B4. intergenerational transmission plus fertility plus educational assortative mating.

Effects estimated from scenario B1 correspond to conventional estimates of the effect of mothers' schooling on offspring's schooling based on the conditional joint distribution of parents' and offspring's schooling. Effects estimated from scenarios B2 through B4 modify conventional estimates by taking account of either fertility or marriage or both.

Alternative Marriage Markets. The effect of a change in the distribution of women's schooling depends on changes in women's preferences and opportunities for marriage. How a change in women's attainment affects the next generation may depend on how the attainments of *men* respond to changes for women because men's aggregate responses determine the possible combinations of men and women who marry, and bear and raise children. A range of male responses is possible. At one extreme, men's attainments are entirely endogenous to those of women. That is, men respond to changes in women's educational attainments so as to maintain the prior conditional distributions of husband's educational attainment given wife's attainment. In this case, women's increased educational attainments do not constrain their marital opportunities; that is, after an aggregate shift in women's attainments, women at each level of educational attainment have the same expected distribution of husband's educational attainment that their counterparts would have faced before the aggregate change. This extreme case is only realistic if men are given the same rewards and inducements to increase their schooling as women.

At the other extreme, men's educational attainments are unaffected by shifts in the education distribution of women. Instead, their education distribution remains constant. In this case, women's marital opportunities are constrained by the available distribution of men. Given the strongly positive observed association between wife's and husband's education, an aggregate increase in women's educational attainments will make the distribution of expected husband's attainments less favorable after the aggregate shift in women's attainment than before. This extreme case is only realistic if the norms, costs, and rewards connected to men's schooling are independent of the educational status of women.[14]

To show the range of possible effects of assortative marriage, we simulate the expected education distributions of offspring under each extreme assumption:

C1. The expected conditional distributions of husbands' educational attainments given wives' attainments remain unchanged; that is, men's education distributions change in response to changes in women's education distributions. We term this the "Unconstrained Marriage Market."

C2. The expected unconditional (marginal) distribution of husbands' educational attainments given wives' attainments remains unchanged; that is, men's education distributions do not change in response to changes in women's education distributions. We term this the "Constrained Marriage Market." [15]

Results. Taken together, these combinations of alternative hypotheses produce 48 simulations. We report the full set of results in Appendix Tables A1 and A2. Figures 4 and 5 show the key findings. The graphs show estimates for the females in the next generation, but similar patterns are observed for males (see tables A1 and A2). Each line on the graphs corresponds to a single comparison (in the form of a ratio) of the expected proportion of offspring in each education category for a given simulation to the expected proportion in the absence of a shift in the education distribution of women (the baseline distribution). A ratio greater than 1.0 indicates an increasing proportion of offspring in that education category. The top and bottom panels of Figure 4 show the estimated effects of moving five percent of women from senior secondary to post secondary schooling and from no education to the elementary school level, respectively. Moving five percent of women from senior secondary to post secondary schooling substantially raises the proportion of children in the next generation who themselves attain post secondary schooling. The size of this effect, however, depends considerably on which aspects of the educational reproduction process are taken into account. In the unconstrained marriage market (shown on the left of Figure 4), the change implied by the conditional intergenerational effect of mother's on daughter's schooling is almost 10 percent.[16] This is, however, an overestimate of the total effect because it ignores the offsetting effects of differential fertility. When the effects of fertility as well as intergenerational transmission are both included, the expected effect on the next generation is about 2.5 percent, only a quarter of the original estimate. In contrast, assortative mating tends to reinforce the effects of intergenerational transmission. Transmission and marriage together raise the proportion of daughters with post secondary education by almost 15 percent. Taking all effects into account, the net impact of a transfer of five percent of women from senior secondary to post secondary schooling is an increase in the proportion of the daughter generation with post secondary schooling of approximately five percent. These patterns show that marriage, fertility, and intergenerational transmission combine to affect the next generation in a complex way. At the upper end of the women's education distribution, increases in attainment bode well for the next generation because more of these women will marry highly educated husbands and because improvements in both mother's and father's education benefit the children they bear. These effects in the next generation, however, are offset by reduced fertility to highly educated women. The net impact of the change in women's education is positive, but not nearly as great as an analysis of intergenerational transmission alone would imply.

Moving five percent of women from no education to elementary education also improves the education distribution of the next generation, but the pattern of effects is different here. Unlike at the top of the schooling distribution, where the effect is concentrated in a single education category, at the bottom of the distribution the effect is spread over several categories. It reaches a maximum value at senior secondary schooling, where the proportion of daughters is expected to increase by approximately five percent. This reflects the overall tendency for daughters to exceed the education level of women in the previous generation, which is reinforced by improvements in women's educational attainment at the bottom of the schooling distribution. Unlike at the top of the education distribution, the estimated effects due to intergenerational transmission alone are similar to those when transmission, fertility, and marriage are considered together. Because women's fertility is nearly constant across the lower strata of women's educational attainment, the benefits to children of improvements in women's education in those strata are not offset by corresponding declines in fertility. The improved marriage prospects that accrue to women when their educational attainment improves have a net positive effect on the education of the next generation, but these effects are small relative to those that occur for improvements at the top of the women's education distribution.

Improvements in women's status at either the top or the bottom of the education distribution improve the education of the next generation in part through the improved marriage prospects of better educated women. Figure 4 shows that these effects are robust to alternative extreme assumptions about the marriage markets that women face. Our findings are similar whether or not we assume that men obtain more schooling in response to an improvement in the women's educational attainment distribution. The expected education effects are similar in the two marriage markets, although the effects are slightly attenuated when the market for men is constrained. That these alternative marriage market assumptions represent extremes in how men might respond to improvements in women's schooling suggests that, at least for marginal changes in women's educational attainment, our findings for Indonesia do not depend on specific marriage market assumptions.

Figure 5 reports the estimated effects of a more extreme change in the distribution of women's educational attainment, namely a redistribution of five percent of women from the lowest to the highest education category. This is tantamount to examining the effect of implementing simultaneously all four shifts of five percent of women to the next highest education category. Because this is a larger change in the distribution of women's educational attainment, the estimated effects are much larger, especially in the change in the proportion of the next generation that achieves post secondary schooling. In the unconstrained marriage market, the expected proportion of the next generation in the elementary through senior secondary education categories implied by fertility, marriage, and intergenerational transmission combined is lower than implied by intergenerational transmission alone. In contrast, at the post secondary level, the combined effect of all three processes implies a much larger growth in the proportion of the next generation than the effect of intergenerational transmission alone (approximately 28 percent versus 12 percent). This pattern of effects results from the reinforcing positive impact of assortative mating and the offsetting negative effect of fertility on the education of the next generation. The redistribution of five percent of women from the lowest to the highest education category results in a very large increase in the expected educational attainment of their husbands. This implies much higher educational attainment for the couples' daughters. This effect, however, is offset to some degree by the lower fertility of these highly educated women. In the absence of fertility reductions for these women, the expected increase in the proportion of daughters achieving post secondary schooling would be even higher (38 percent versus 28 percent).

In the constrained marriage market the effects of redistributing five percent of women from the no education category to post secondary schooling follows a broadly similar pattern to the unconstrained marriage market. In this case, however, the educational attainments of daughters are dampened throughout the education distribution. Indeed, a lower proportion of daughters is expected to attain even secondary school in the constrained market after the redistribution of women's educational attainment relative to before the redistribution. This pattern of effects is a result of the constrained marital opportunities implied by this simulation. The large redistribution of women's educational attainment, combined with a fixed distribution of men's educational attainment, implies that not all women will be able to marry the highly educated men that they would otherwise expect to marry. Because women at the highest level of educational attainment get "first choice" in the constrained marriage market, the marriage opportunities for women in the lower education categories are made worse and their offspring's educational attainment is lowered beyond the level that they would obtain in an unconstrained marriage market. This results in nearly no change in the distribution of girls in the no education category relative to the predicted baseline distribution (ratio of about 1). When the marriage market is not constrained, on the other hand, the predicted proportion of girls with no schooling is about 10 percent less than in the baseline distribution (ratio of about 0.9).[17]

SUMMARY AND CONCLUSIONS

How one views the effects of family background on socioeconomic attainment depends on how one thinks about assessing the consequences of changing the characteristics of individuals' families of orientation. Many real or hypothetical changes in the socioeconomic characteristics of parents – especially those that change the educational attainments of mothers or fathers – occur relatively early in their lives. These early changes affect parents' fertility and marriage as well as the attainments of their offspring. But changes that affect fertility and marriage cannot be adequately assessed from observations of parent and offspring socioeconomic characteristics alone. If a change in women's educational attainments changes their fertility and marriage behavior, then this alters the relative numbers of children in the offspring generation born to women from varying education levels and this, even in the absence of change in the family and individual level effects of mother's schooling on offspring's schooling, changes the distribution of schooling in the offspring generation. Our models take account of these features of intergenerational effects and reveal how the various components of intergenerational change contribute to the total effect of the educational attainment of a population of women on the education of the next generation.

The model proposed here is only a single step in assessing the aggregate intergenerational effects that are typically ignored in standard analyses of parent-child associations. It can, however, be extended to take account of a richer set of mechanisms, including the timing of fertility and marriage, the instability of marriage, mortality of parents and children, sex-specific effects of family background characteristics on offspring, unobserved factors that commonly affect fertility and offspring's educational attainment, and more complex marriage market effects. Increases in women's educational attainment may affect whether and when they marry, the timing of fertility, and whether women have children outside of marriage. These mechanisms may have relatively larger effects in low fertility societies than the assortative mating and fertility level effects considered in this paper. In poor, high fertility societies, in contrast, the impact of a change in the distribution of women's educational attainment may affect the next generation through resulting changes in the probability that women survive through the childbearing years, thereby increasing their total exposure to childbearing and providing more care to the children whom they bear, and that their children themselves survive to adulthood. Additional individual and family effects may be important in some societies, including sibship size and interactions between sex of child and sex of parent (Thomas 1994; Mare and Chang [forthcoming]). If mothers and fathers have distinct effects on their daughters and sons, then changes in the distribution of women's educational attainment may, depending on the structure of educational assortative marriage, differentially alter the education distributions of men and women in the next generation.

The analyses reported in this paper assume that, given the variables measured in the analysis, the marriage, fertility, and intergenerational transmission processes are independent. If, however, women vary systematically on unmeasured factors that jointly affect marriage, fertility, and childrearing, then the estimated effects of parents' educational attainments on their offspring's schooling may be subject to a "selection bias," created by differential fertility (Winship and Mare 1992). If, for example, among women with the same educational attainment, those who can provide the best environments for their children are those who, because of their other opportunities, have the fewest children, then the estimated effects of mother's on offspring's schooling may be biased downwards. Although we typically regard "family background" as exogenous to socioeconomic success, when we consider the unconditional effects of women's characteristics on the next generation, it may be necessary to treat family background as jointly determined with the outcomes of family effects such as offspring's educational attainment and economic success.

A full account of how marriage contributes to the effects of a change in young women's education distributions on the next generation requires the development of two-sex models of entry into marriage and assortative marriage that make explicit the interdependence of the male and female populations (Logan, Hoff, and Newton 2001; Mare 2000). As illustrated in this paper, although the estimates for the effects of some changes in women's education distributions are robust to alternative assumptions about marriage markets, for other effects alternative assumptions about marriage yield different predictions. Models that enable one to estimate rather than assume the parameters of the marriage process are needed for a fuller understanding of these effects.

Although these refinements to our approach are desirable lines of future research, our present analysis demonstrates, in the Indonesian context, the existence of several important mechanisms of educational reproduction. The effects of women's educational attainment on the next generation are more complex than a conventional analysis of mother-offspring educational mobility reveals. Positive educational assortative mating tends to reinforce the beneficial effects of increased women's schooling. Women who obtain more schooling provide better environments for their children both directly and indirectly through their marriage to better educated men. At higher levels of educational attainment, however, the dampening effects of education on women's fertility tends to offset the beneficial effects of marriage and women's education itself on the next generation. Thus, the long run effects of interventions to raise women's schooling may depend on where in the education distribution these efforts are applied. Interventions among the most poorly educated women appear to be an unalloyed benefit for both the current and future generation. Interventions among better educated women may benefit them directly but have a limited or, in some populations, even negative effect on the education distribution of the next generation.

Unlike more conventional models of intergenerational transmission, our approach to the assessment of intergenerational effects is suitable for assessing the long run, intergenerational consequences of interventions in the lives of teenagers and young adults. In low education populations, which still characterize large parts of the developing world and immigrant populations in the developed world, efforts to increase educational attainment of women continues to be a promising avenue of human betterment. Models of the type presented in this paper may prove to be a good way to quantify these effects. But these contexts certainly are not the only ones to which our approach applies. Differences in marriage, fertility and offspring's schooling by women's schooling are also important features of populations with relatively high levels of educational attainment such as the United States. Finally, in addition to the descriptive and practical value, these models are a foundation for dynamic empirically-based analyses of intergenerational reproduction (Mare 1997, 2001). These models advance mobility studies beyond a static focus on who gets ahead to a more dynamic view of how populations and societies change.

ENDNOTES

[1] This view, however, is not without its critics. Some investigators maintain that the correlation between women's educational attainments and the well-being of their children is spurious (e.g., Behrman and Rosenzweig 2002), whereas others argue that mechanisms other than raising women's educational attainments may be more effective avenues of social and economic change (e.g., Knodel and Jones 1996).

[2] This part of the discussion assumes that the individual level effect of mother's educational attainment on child's attainment is unambiguously positive. In societies in which a child's number of siblings has a positive effect on child's attainment, the individual level effect of raising mother's educational attainment may have a mixture of positive net mother's education effects and negative effects through the reduction in number of siblings. Even in this case, however, the total effect of mother's educational attainment on child's attainment is still likely to be positive.

[3] Fertility timing effects are not included in the analyses reported in this paper, although it is possible to add them to the models presented here.

[4] A complete treatment of this issue requires a two-sex model of the marriage market, which is beyond the scope of this paper. Logan, Hoff, and Newton (2001) propose a model for the analysis of two-sided matching in the marriage market, albeit outside of the population reproduction framework discussed in this paper.

[5] One can relax the assumption that all women marry by including a fourth term in (2) for the probability that a woman marries and redefining p^H as a woman's conditional probability of marrying a man with a given level of education given that she marries.

[6] The probabilities for offspring's education can also be represented by a multinomial model. In practice, we observe that ordinal and multinomial models yield similar predictions for the offspring's educational distributions examined here.

[7] The probabilities for the education of husbands can also be represented by a multinomial model. In practice, we find that the ordered logit model yields predictions of the husband's education distribution that are very similar to those from the multinomial model. The multinomial model is also one way of incorporating unmarried women into the model for populations where marriage is not universal. Another is to retain the ordered logit model for married women and add a fourth equation for the probability of marriage.

[8] Equations (3)-(5) assume that individuals and families are homogeneous within the categories of the independent variables included in the models and that the three processes are independent; that is, that no common unmeasured variables affect marriage, fertility, and intergenerational transmission. In general, these assumptions may be violated. Extensions of our models that take account of these complications are discussed in the conclusion of this paper.

[9] The descriptive statistics reported in this paper are based on sample data weighted to take account of sample attrition and disproportionate stratification by geographic areas that are included in the IFLS. Our estimated statistical models and simulations are based on unweighted data. Whether or not weights are used in estimating the models has negligible effects on our results.

[10] These simulations all assume that women's educational attainments change through a random draw of women at a given level of educational attainment.

[11] We also considered models that included number of siblings as a regressor in the equation for children's educational attainment. This would seem to be a key variable to include both because of its pervasive association with educational attainment in many other studies (e.g., Blake 1985)

and because it captures the family-level impact of a change in women's fertility on the educational attainment of her offspring. We nonetheless exclude number of siblings from the model because its effects on educational attainment in Indonesia are extremely small and range over cohorts from slightly *positive* to slightly negative (Maralani 2004). In the Indonesian context, therefore, the family level effect of sibship size does not contribute to the overall effect of changes in women's education on the next generation. In most other societies, number of siblings should be included in models of the sort presented here.

[12] Focusing on the effect of redistributing five percent of the population is arbitrary, although, for most of the simulations that we discuss, using an different fraction of the population would simply rescale the estimated effects up or down in proportion to the change in the fraction. Five percent is a number large enough to reveal a discernable pattern of effects yet small enough that it can be applied to each of the first four categories of women's schooling. For example, a redistribution of 10 percent of Indonesian women from senior secondary to post secondary schooling would not be feasible because fewer than 10 percent of women achieve senior secondary education.

[13] In an alternative set of simulations not reported here, we computed counterfactual education distributions under the assumption that 50 percent of women in a given education category moved into a higher category (rather than a number of women equal to 5 percent of all women, as discussed in the text). Given the highly skewed distribution of women's education in Indonesia this alternative method changes the educational attainment of many more women at the bottom of the education distribution than at the top of the distribution. Thus its estimated effects are greater than those reported in the text when women with no education are moved to the elementary or post secondary levels and smaller when women at higher levels of education are moved to adjacent categories.

[14] In neither of these extreme cases do we allow for women to forego marriage altogether, an assumption that is in keeping with historical marriage patterns and education change in Indonesia. As discussed elsewhere in the paper, the models discussed here can be extended to allow for changes in marriage timing and the incidence of nonmarriage.

[15] We constrain the marriage market by adjusting the predicted marriage probabilities $\hat{p}^{H}_{k|i}$ to conform to the existing men's educational distribution under the assumption that marriage is a competitive process in which women with higher levels of educational attainment are more successful in marrying more highly educated men than women with lower levels of education. Our model predicts marriage probabilities and numbers of marriages for each combination of women's and men's schooling. If the predicted number of marriages within a category of men's schooling exceeds the number of men in that category in the original sample, we allow women in the higher education categories "first pick" at the most educated men and force less educated women to take husbands who may have lower educational attainment than they would be able to marry in an unconstrained marriage market. Our algorithm redistributes marriages in this way, with highly educated women always marrying the men with the highest schooling available, until equilibrium is reached. We then calculate the revised marriage probabilities implied by this redistribution and use these adjusted marriage parameters in the simulations.

[16] These estimates are the effects of mother's educational attainment controlling for father's educational attainment.

[17] This pattern is also apparent in the bottom panel of Figure 4, although to a much smaller extent.

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Table 1. Educational Attainment Distributions for Selected IFLS Samples (Percent) [a]

	Marriage/Fertility Sample		Transmission Sample			
Educational Attainment	Woman	Husband	Woman	Husband	Sons	Daughters
None	47.2	29.2	48.0	29.2	6.2	11.0
Elementary	39.8	50.6	40.3	51.3	42.2	47.5
Junior Secondary	6.1	8.7	6.2	8.7	15.3	12.7
Senior Secondary	5.3	8.1	4.5	7.9	25.1	20.8
Post Secondary	1.5	3.4	1.0	2.8	11.2	7.9
Total	99.9	100.0	100.0	99.9	100.0	99.9
# Observations	3938	3938	3236	3236	5403	5417

[a] Data are weighted to adjust for oversampling and attrition.

Table 2. Distribution of Outcomes by Women's Educational Attainment [ab]

	Husband's Education (%)						Children Ever Born	Offspring's Education (%)					
	None	Elem.	Jr. Sec.	Sr. Sec.	Post Sec.	Total		None	Elem.	Jr. Sec.	Sr. Sec.	Post Sec.	Total
Women's Education:													
None	51.8	44.6	2.2	1.3	0.1	100.0	4.8	16.4	59.9	9.9	11.4	2.5	100.1
Elementary	11.5	69.2	12.0	5.8	1.4	99.9	5.2	1.9	39.1	19.8	30.7	8.6	100.1
Junior Secondary	2.4	23.4	32.4	35.9	5.9	100.0	5.0	0.4	4.8	16.2	48.9	29.7	100.0
Senior Secondary	0.3	7.3	14.1	49.2	29.2	100.1	4.1	0.4	1.4	4.5	39.5	54.3	100.1
Post Secondary	0.0	8.5	7.1	23.6	60.9	100.1	3.5	0.0	0.0	2.3	20.9	76.8	100.0
Total	29.2	50.6	8.7	8.1	3.4	100.0	4.9	8.6	44.8	14.0	22.9	9.6	99.9
# Observations				3938			3938				10820		

[a] Data are weighted to adjust for oversampling and attrition.
[b] Totals do not sum to 100 percent due to rounding.

Table 3. Parameter Estimates for Models of Marriage, Fertility, and Intergenerational Transmission[ab]

	Husband's Schooling (Ordered Logit*)		Children Ever Born (Poisson)		Offspring's Schooling (Ordered Logit*)	
	β	β/[S.E.(β)]	β	β/[S.E.(β)]	β	β/[S.E.(β)]
Women's Education (vs. None)						
Elementary	2.014	24.3	0.008	0.3	0.936	12.8
Junior Secondary	4.072	31.2	-0.064	-1.6	1.725	14.0
Senior Secondary	5.571	35.5	-0.210	-4.5	2.346	16.4
Post Secondary	6.940	22.6	-0.418	-5.6	3.160	6.9
Husband's Education (vs. None)						
Elementary			0.090	3.5	0.969	11.3
Junior Secondary			0.093	2.4	1.776	14.5
Senior Secondary			0.086	2.2	2.348	18.1
Post Secondary			0.019	0.3	3.362	14.6
Child's Sex (1=girl)					-0.477	-12.4
Intercept			1.587	77.5		
# Observations	3938		3938		10820	
Log Likelihood	-3944.0		-10161.7		-13155.2	

[a] Cutpoint parameters are not shown.

[b] Ratios of coefficients to standard errors use robust standard errors.

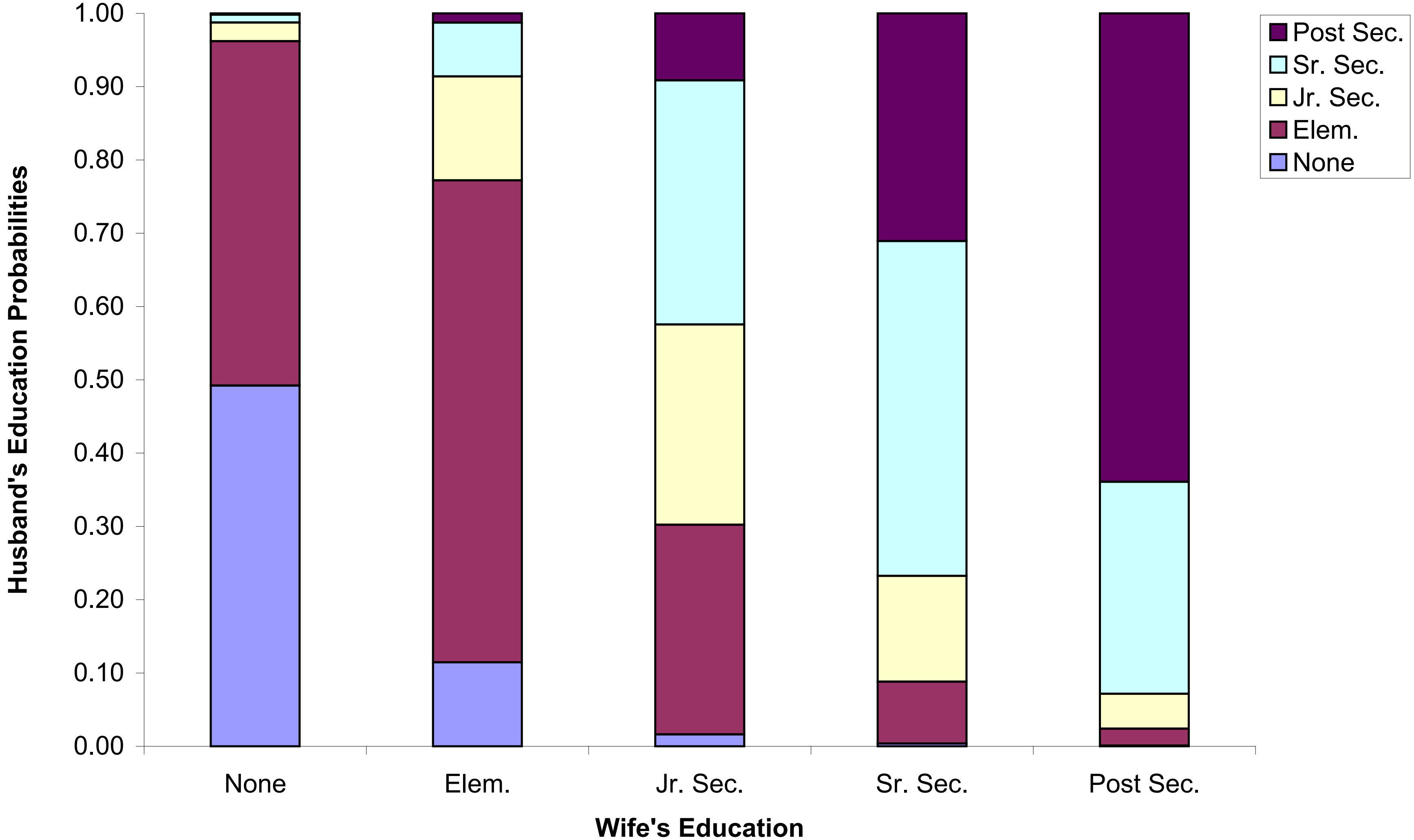

Figure 1. Husband's Education Given Wife's Education

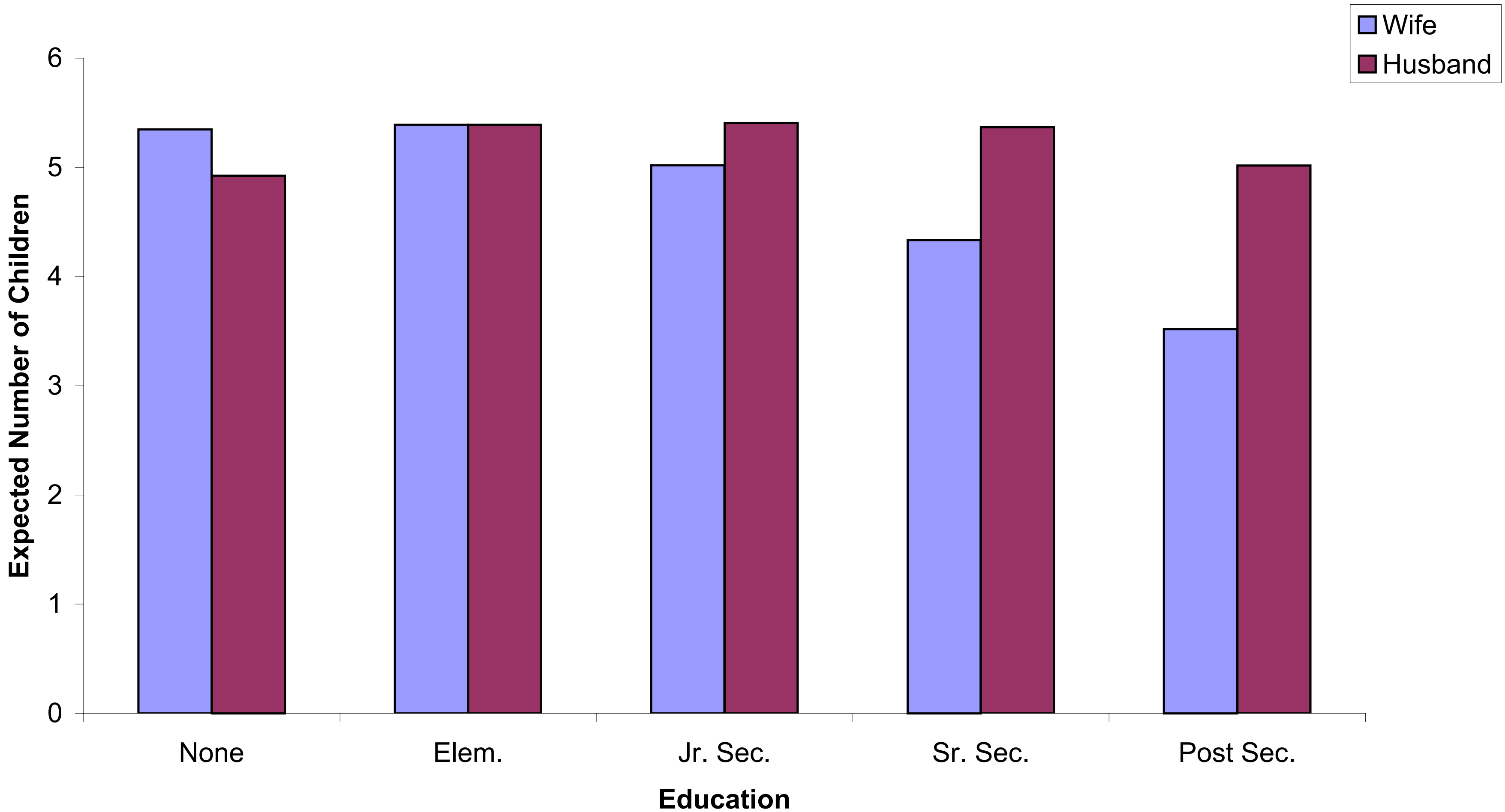

Figure 2. Fertility by Educational Attainment (Spouse's Education Held at Elementary)

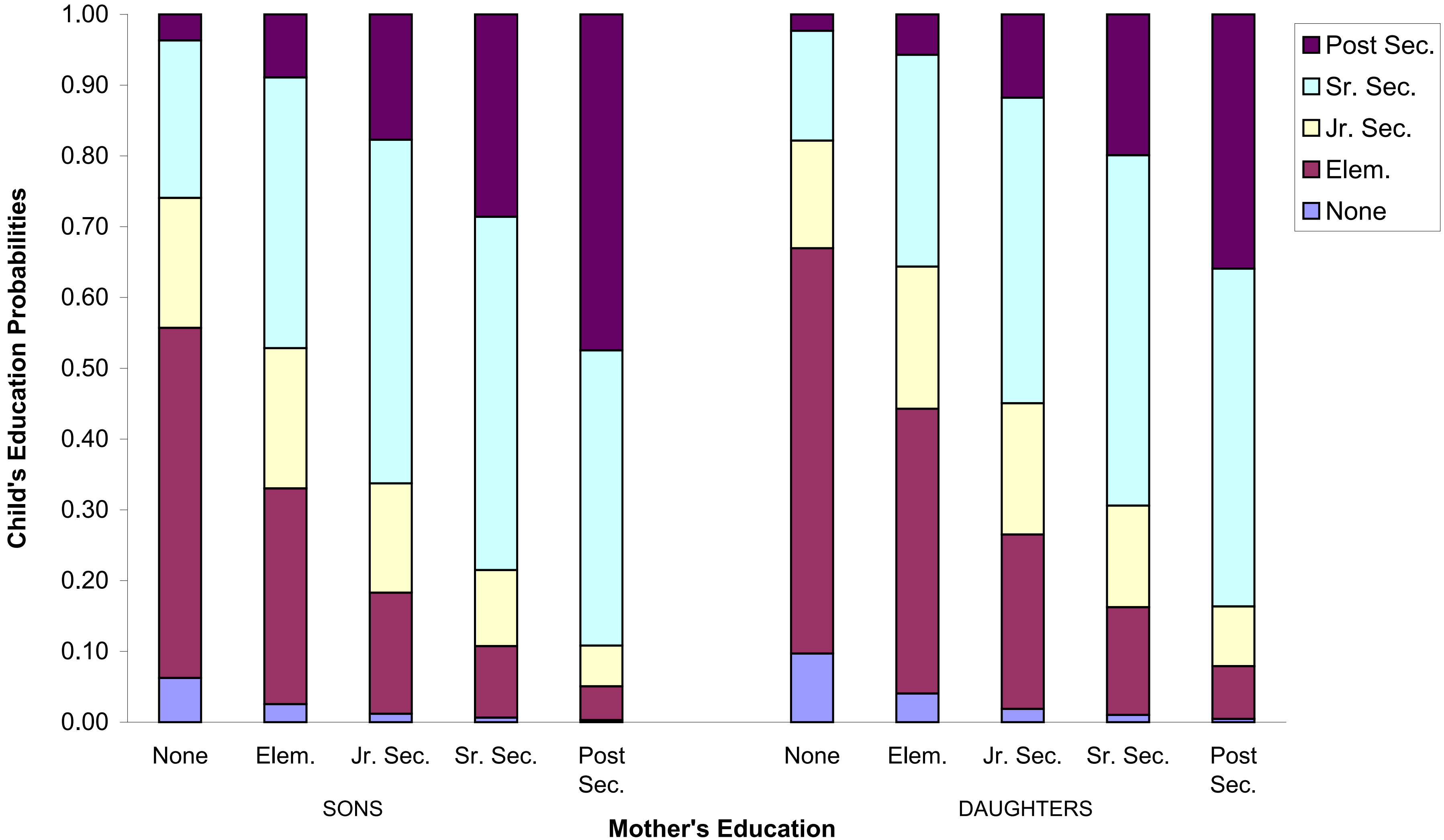

Figure 3. Offspring's Education Given Mother's Education (Father's Education held at Elementary)

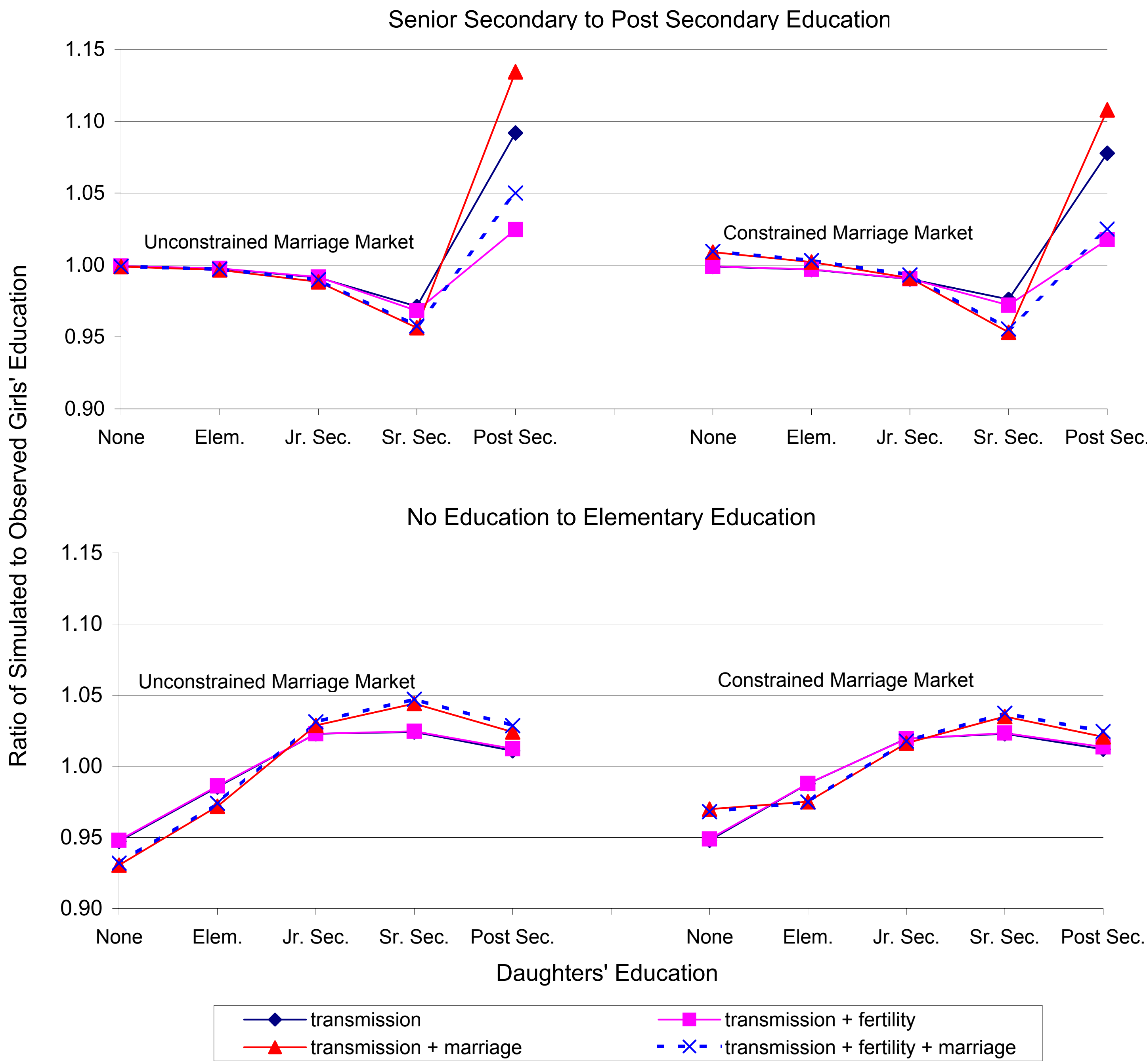

Figure 4. Effects of Redistributing Five Percent of Women Across Adjacent Education Categories

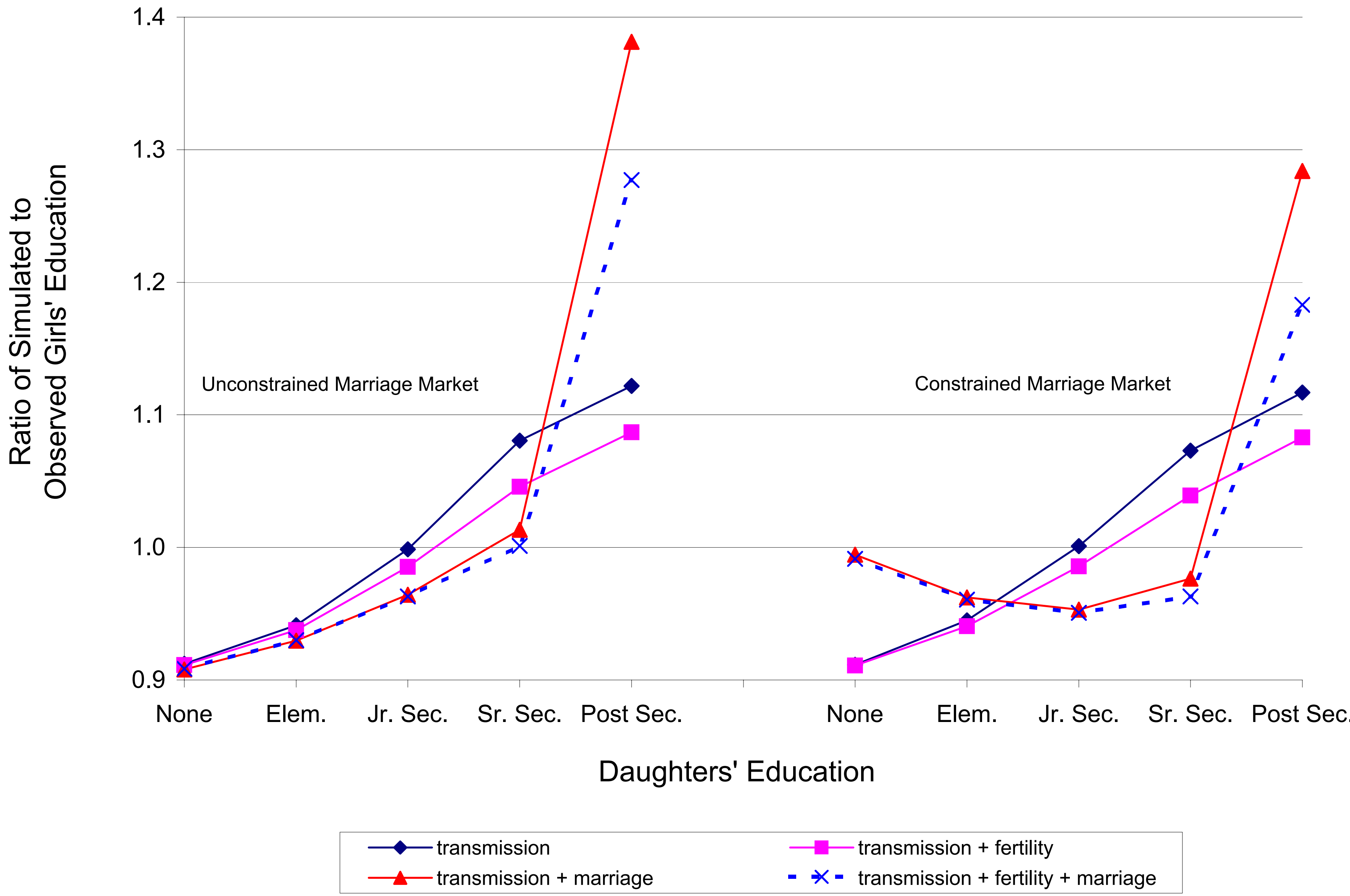

Figure 5. Effects of Redistributing Five Percent of Women from No Education to Post Secondary Education

Appendix Table A1. Ratios of Simulated to Observed Offspring's Education Distributions, Unconstrained Marriage Market

	Sons					Daughters				
	None	Elem.	Jr. Sec.	Sr. Sec.	Post Sec.	None	Elem.	Jr. Sec.	Sr. Sec.	Post Sec.
Simulation	Transmission Only					Transmission Only				
None to Elem.	0.946	0.976	1.015	1.025	1.013	0.947	0.985	1.023	1.024	1.011
Elem. to Jr. Sec.	0.988	0.983	0.984	1.015	1.035	0.988	0.982	0.992	1.026	1.033
Jr. Sec. to Sr. Sec.	0.998	0.995	0.989	0.987	1.054	0.998	0.994	0.985	0.993	1.064
Sr. Sec. to Post Sec.	0.999	0.998	0.994	0.978	1.058	0.999	0.997	0.991	0.971	1.092
None to Post Sec.	0.911	0.932	0.976	1.054	1.125	0.912	0.941	0.999	1.081	1.122
	Transmission + Fertility					Transmission + Fertility				
None to Elem.	0.946	0.977	1.015	1.025	1.014	0.948	0.986	1.023	1.025	1.012
Elem. to Jr. Sec.	0.987	0.981	0.980	1.010	1.035	0.986	0.980	0.987	1.021	1.033
Jr. Sec. to Sr. Sec.	0.997	0.995	0.987	0.978	1.032	0.997	0.993	0.982	0.981	1.042
Sr. Sec. to Post Sec.	0.999	0.998	0.995	0.977	1.003	0.999	0.998	0.992	0.968	1.025
None to Post Sec.	0.910	0.930	0.968	1.026	1.087	0.911	0.938	0.985	1.046	1.087
	Transmission + Marriage					Transmission + Marriage				
None to Elem.	0.929	0.961	1.013	1.042	1.028	0.931	0.972	1.029	1.044	1.024
Elem. to Jr. Sec.	0.983	0.973	0.966	1.014	1.088	0.982	0.971	0.973	1.037	1.087
Jr. Sec. to Sr. Sec.	0.997	0.993	0.981	0.969	1.108	0.996	0.990	0.974	0.976	1.136
Sr. Sec. to Post Sec.	0.999	0.998	0.993	0.968	1.082	0.999	0.997	0.988	0.956	1.134
None to Post Sec.	0.907	0.924	0.953	0.993	1.305	0.908	0.930	0.964	1.013	1.381
	Transmission + Fertility + Marriage					Transmission + Fertility + Marriage				
None to Elem.	0.930	0.963	1.015	1.045	1.032	0.932	0.974	1.031	1.047	1.029
Elem. to Jr. Sec.	0.982	0.971	0.963	1.008	1.091	0.981	0.969	0.969	1.031	1.092
Jr. Sec. to Sr. Sec.	0.996	0.992	0.981	0.962	1.078	0.996	0.990	0.973	0.965	1.106
Sr. Sec. to Post Sec.	0.999	0.998	0.994	0.970	1.016	0.999	0.997	0.990	0.958	1.050
None to Post Sec.	0.908	0.924	0.952	0.986	1.217	0.908	0.930	0.963	1.001	1.277

Appendix Table A2. Ratios of Simulated to Observed Offspring's Education Distributions, Constrained Marriage Market

	Sons					Daughters				
	None	Elem.	Jr. Sec.	Sr. Sec.	Post Sec.	None	Elem.	Jr. Sec.	Sr. Sec.	Post Sec.
Simulation	Transmission Only					Transmission Only				
None to Elem.	0.946	0.980	1.013	1.023	1.014	0.948	0.988	1.020	1.023	1.012
Elem. to Jr. Sec.	0.988	0.983	0.987	1.013	1.034	0.987	0.983	0.993	1.022	1.033
Jr. Sec. to Sr. Sec.	0.997	0.994	0.989	0.990	1.047	0.997	0.993	0.986	0.995	1.055
Sr. Sec. to Post Sec.	0.999	0.998	0.993	0.980	1.052	0.999	0.997	0.990	0.976	1.078
None to Post Sec.	0.910	0.936	0.980	1.050	1.117	0.911	0.945	1.001	1.073	1.117
	Transmission + Fertility					Transmission + Fertility				
None to Elem.	0.946	0.980	1.013	1.023	1.015	0.949	0.988	1.019	1.023	1.014
Elem. to Jr. Sec.	0.987	0.981	0.983	1.008	1.033	0.986	0.981	0.989	1.017	1.033
Jr. Sec. to Sr. Sec.	0.997	0.994	0.986	0.981	1.025	0.997	0.992	0.983	0.984	1.035
Sr. Sec. to Post Sec.	0.999	0.998	0.994	0.979	1.002	0.999	0.997	0.990	0.972	1.018
None to Post Sec.	0.909	0.933	0.970	1.022	1.081	0.911	0.941	0.986	1.039	1.083
	Transmission + Marriage					Transmission + Marriage				
None to Elem.	0.971	0.970	1.001	1.032	1.024	0.970	0.975	1.016	1.035	1.021
Elem. to Jr. Sec.	1.037	0.986	0.952	0.999	1.080	1.033	0.976	0.957	1.023	1.081
Jr. Sec. to Sr. Sec.	1.019	1.003	0.981	0.961	1.089	1.018	0.998	0.971	0.967	1.115
Sr. Sec. to Post Sec.	1.009	1.004	0.996	0.968	1.059	1.009	1.002	0.991	0.953	1.108
None to Post Sec.	0.998	0.966	0.954	0.964	1.219	0.994	0.962	0.953	0.976	1.284
	Transmission + Fertility + Marriage					Transmission + Fertility + Marriage				
None to Elem.	0.969	0.969	1.002	1.034	1.027	0.968	0.975	1.018	1.037	1.024
Elem. to Jr. Sec.	1.034	0.983	0.950	0.994	1.083	1.030	0.974	0.954	1.018	1.086
Jr. Sec. to Sr. Sec.	1.019	1.003	0.981	0.955	1.060	1.018	0.998	0.970	0.956	1.086
Sr. Sec. to Post Sec.	1.010	1.005	0.998	0.971	0.994	1.009	1.003	0.993	0.956	1.025
None to Post Sec.	0.994	0.964	0.952	0.955	1.133	0.991	0.961	0.951	0.963	1.183