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Abstract

In this paper, we explore evidence concerning the relationship between parents' and children's education using a new body of data, the Second Malaysian Family Life Survey (MFLS-2), which contains information on the education of up to four generations of persons within a given family. This data allows us to study the spread of education in Malaysia over much of this century by examining the educational attainment of birth cohorts from 1910 to 1980. More importantly, we use this data to study the effects of parental education on the progress of their children through elementary, secondary and post-secondary school within a sequential discrete-time hazard model which allows for correlations among unmeasured family and individual-specific components. For a subset of the cohorts, we are able introduce time-varying covariates to measure the family's economic circumstances, the quality of its environment, and the composition of the sibset at the time a given decision is made.

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I. INTRODUCTION

Modern theories of economic growth have given increasing emphasis to the close linkage between investment in human capital and growth in per capita income, on the one hand, and fertility and mortality decline, on the other (e.g., Becker, Murphy, and Tamura, 1990; Meltzer 1991), thereby providing a formal basis for the theory of demographic transition. Underlying such theories of aggregate economic and demographic change are microeconomic theories of the family in which decisions about fertility and the education of children depend on the interplay of parental preferences and constraints faced by the family.[1] One important application of this theory is to provide a conceptual framework with which to explore intergenerational mobility in the transmission of human capital and income within families (see, e.g., Becker and Tomes 1976, 1979, 1984).

In this paper, we explore some of the key empirical relationships suggested by this conceptual framework concerning the relationship between parents' and children's education using a new body of data, the Second Malaysian Family Life Survey (MFLS-2), which contains information on the education of up to four generations of persons within a given family. This data allows us to study the spread of education in Malaysia over much of this century by examining the educational attainment of birth cohorts from 1910 to 1980. In particular, we are able use this data to study the effects of parental education on the progress of their children through elementary, secondary, and post-secondary school within a sequential choice discrete-time hazard model which allows for correlations among unmeasured family and individual-specific components. For a subset of the cohorts, we are able to introduce time-varying covariates to measure the family's economic circumstances, the quality of its environment, and the composition of the sibset at the time a given decision is made.[2]

A. Malaysian Background

Malaysia provides a fascinating laboratory for the application of such theories. Like other countries in East and Southeast Asia, Malaysia has experienced very rapid economic growth, averaging 4 percent growth in per capita GDP from 1965-88 to reach a level of per capita income of nearly $2000 by 1988 (World Bank 1990, Table 1). This growth rate is similar to rates in Japan, Indonesia, and Thailand, but significantly lower than South Korea's 6.4 percent growth and much higher than the 1.6 rate of growth in the Philippines. As we show in this paper, Malaysia has also experienced rapid growth in the educational attainment of its population with virtually complete elimination of gender differentials in years of schooling.

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[1] See, e.g., Willis (1987) for a brief survey and further references and Becker (1991) for a comprehensive development of the theory of the family.

[2] For recent studies of educational behavior using U.S. data and statistical models that are similar in some respects to the model used in this paper, see Mare (1991) and Cameron and Heckman (1992).

Over this period, fertility has declined dramatically in nearly all countries of the region, including Malaysia. However, in a very interesting paper, Jones (1990) shows that the fertility decline was concentrated in the Chinese and Indian minority groups, with the total fertility rate in these groups falling from about 7.0 in 1958 to about 3.0 by 1988. In contrast, period fertility of the majority of Malays declined more modestly in 1958 until the mid-1970's and then began to rise until the mid-1980's, reaching a level of about 5.0 in 1986. Moreover, the period fertility decline that did occur among Malays appears to be due entirely to a rise in the age at marriage with no apparent decrease in completed family size. This pattern contrasts not only with decreased completed fertility among Chinese and Indians in Malaysia but also with similar fertility declines among ethnic Malays in Singapore and Indonesia.

Jones suggests that the failure of Malay fertility in Malaysia to decline during a period when the fertility of other groups in Malaysia and elsewhere in the region was declining might be explained by the operation of the New Economic Policy (N.E.P.), which has made it possible for Malay families to educate their children and be assured of their successful employment at very little personal cost. Adopted in 1970 following race riots in 1969, the stated aim of the N.E.P. was to eradicate poverty regardless of ethnicity and to eliminate the identification of ethnicity with economic functions (Malaysia 1971, as quoted in Govindasamy 1991). It has since evolved into "...one of the most radical affirmative action programs ever implemented by a government" (Scott 1991, p.63). On the one hand, the N.E.P. has imposed increasingly onerous burdens on Chinese and Indian racial groups through the elimination of Chinese, Tamil, and English language secondary schools, through the erection of barriers to government jobs and enforcement of employment quotas in private firms, and by enforced participation of Malays in business ownership.[3] According to Jones (1990), "...this has lead to a steady outmigration of Chinese and Indian professionals, most of whom when questioned claim that they moved because they worry about the future of their children in Malaysia (p. 524)." He goes on,

"By contrast, Malay children who show promise, even those from poor rural

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[3]The N.E.P. represents a continuation of policies codified in the Malaysian Constitution in 1957 which reaffirmed "special position of the Malays" by reserving for them four-fifths of all jobs in the civil service, three-fourths of university scholarships and training programs, and a majority of license permits for the operation of trade and business (Snodgrass 1978). In addition, the 1961 Education Act was the first of a long series of acts to regulate language of instruction. It restricted teaching in secondary government schools to either Malay or English. Beginning in 1970, the Malaysian Ministry of Education began to implement a program to convert English language schools to Malay language schools beginning with Standard 1 and continuing one grade per year through two post-secondary Standards until all secondary schools were converted to Malay in 1982 (DeTray 1984). In the late 1980's, the Malaysian government extended this policy to conversion of government elementary schools to the exclusive use of Malay language. In addition, beginning in the 1960's, only Malay language schools were tuition free although DeTray (1984) reports that fees were often waived for Malay children enrolled in English schools.

> families, have every chance of succeeding. Scholarships have been readily available at the secondary and tertiary level to support bright Malay children. Even in villages of the poorest state of Kelantan, it is common to find parents who have one or more children in universities overseas. Expansion of public service employment has benefited the Malays almost exclusively, and the public service sector expanded very rapidly over the 1970's and early 1980's. This was a time when, despite the large numbers of Malays graduating from universities, both in Malaysia and abroad, there appeared to be no shortage of job opportunities (p. 524)."

One of the goals of this study is to use the new MFLS-2 data will to see whether the N.E.P. policies have had a major impact on racial differentials in educational attainment.[4]

B. Theoretical Issues

Theories of parental investment in children suggest several channels through which family economic circumstances may influence their children's educational attainment. One influential line of theorizing, pioneered by Becker (1991) and Becker and Tomes (1976, 1979, 1984), hypothesizes that parents are altruistic toward their children in the sense that they care about their children's welfare. Assuming that parents face a "perfect capital market" (i.e., they can borrow and lend at a given interest rate) and disregarding non-pecuniary returns to education, risk and other complications, the Becker-Tomes theory suggests that parental decisions can be decomposed into two steps: (1) maximize the joint wealth of the entire family line by investing in the human capital of each child up to the point at which the marginal rate of return is equal to the rate of interest and (2) redistribute the resulting maximized wealth among family members so as to maximize the preferences of the altruistic head of the household. This redistribution may involve intergenerational transfers in either direction. For example, in addition to resources they spend on their children's human capital, wealthy parents may make monetary transfers such as gifts or bequests. Conversely, poor parents may demand that part of their investment in a child's schooling to be regarded as a 'loan' which the child repays at a later date in, say, the form of old age transfers or, alternatively, the parent must be able to transfer the debt to the child.

In any case, assuming altruism and a perfect capital market, optimal investment is independent of the degree of parental altruism, parental wealth or the number and gender composition of the sibset. The only reason for variation in investment in education is variation in the returns to education. The source of such variation might be individual-specific factors such as variation in the ability of individual children or family-specific components such as common

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[4]See also Pong (1992) for an examination of this question using MFLS-2 data.

genetic or environmental factors shared by family members. The statistical model that we employ in this paper allows for both measured and unmeasured individual and family-specific factors.

Investment may also vary because of society-wide changes in the pattern of labor demand such as the increase in the relative demand for educated labor that occurs when there is a shift in economic activities from traditional agricultural occupations to modern industry and services in urban areas during the process of economic development.

Still another potential source of variation in family education decisions is labor market discrimination according to race or sex. Note, however, that the direction of the effect of discrimination on optimal educational investment is ambiguous. For example, if discrimination is relatively greater in low-skilled than in high-skilled occupations, the percentage gain in earnings from increased education is greater for those who are discriminated against. Thus, there could be higher rather than lower levels of education as a result of discrimination. This ambiguity is important to bear in mind when considering the potential effects on educational attainment of discrimination in the labor market faced by Chinese under the N.E.P. policies since the Chinese have traditionally been more urban and in more skilled occupations than Malays.[5] However, to the extent that one of the major benefits of the N.E.P. to Malays is to help them acquire the credentials for 'good' government jobs, the effects might increase the relative level of education of Malays, especially at the post-secondary level.

The Becker-Tomes model, for example, would generate variations in investment in education if the costs or availability of schooling varied. The supply of schooling has improved over time in Malaysia, spreading from urban into rural areas.

An important set of issues arises about parental investment in children's education when one drops the 'perfect capital market' assumption. Suppose for a moment that there is only one child and that parents cannot encumber their children with debt or that children cannot effectively repay their parents (e.g., because the parent will be dead when the educated child is in a position to repay). In this case, the Becker-Tomes model suggests the amount that poor parents are willing to invest in the child's education will be smaller than the optimal amount, but that this amount will be an increasing function of parental income up to the point at which the marginal return to investment is equated to the rate of interest. Further increases in parental income would have no effect on education. While parents may escape credit constraints to some extent by treating some of their expenditure on children as a loan, the risk that children may default may lead either to lower investment or to distortions such as attempts to keep children from migrating in order to

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[5]If the only cost of schooling is foregone earnings, the percentage increase in earnings per additional year of school measures the rate of return to education. If there are also direct costs of schooling such as tuition, however, the return to education might be lower for individuals who are discriminated against even if they enjoy a higher percentage increase in income from increased education. The increase in tuition costs faced by Chinese families due to the N.E.P. would tend to reinforce this effect.

lower default risk.

Recently, Behrman, Pollak, and Taubman (1991) have shown that the analysis of investment in children's education by credit-constrained parents becomes quite complicated when there is more than one child because the constraint forces the parents to choose among children and therefore depends on the degree to which parents care about different children and how willing they are to substitute among them. In an analysis of the determinants of educational attainment in Taiwan, Parish and Willis (1992) found stronger effects of parental income variables and the size and gender composition of sibsets on educational attainment among persons born in earlier cohorts or from low income households compared to persons in later cohorts or from wealthier families. They suggest that this evidence of higher sensitivity to economic and demographic constraints might be interpreted as evidence that such households were more credit constrained than were more recent cohorts and wealthier families. The same questions are addressed with the analysis presented in this paper.

Another interesting hypothesis about gender differentials in education among Chinese families has been advanced by Greenhalgh (1985). She argues that rising levels of educational attainment of girls relative to boys in Taiwan is not evidence of a reduction of the traditional favoritism of Chinese families for male offspring who will care for them in old age and disfavor for daughters who will leave their family of origin when they marry. Rather, Greenhalgh suggests that rapid economic growth and the concomitant increase in the skill-intensity of labor demand makes it rational to increase investment in daughters' education if the family can obtain repayment before the young woman leaves her family of origin. She suggests that remittances from unmarried daughters are used to finance the education of sons who, following tradition, are expected to support the parents in old age. In a small sample of Taiwanese households, she finds support for this hypothesis from evidence that, *ceteris paribus*, having an older sister instead of an older brother apparently increases a boy's educational attainment. In a larger body of Taiwanese data, Parish and Willis (1992) obtain a similar effect, except that they find older sisters are relatively beneficial for younger siblings of either sex.

Malaysia provides an interesting setting in which to examine the effects of gender composition of sibsets in both Chinese and non-Chinese families. There is evidence from both fertility behavior and living arrangements of racial differences in son preferences in Malaysia. Specifically, using fertility data from the first wave of the Malaysian Family Life Survey (MFLS-1), Leung (1988) finds evidence of son preference among Chinese but none for Malaysian families and there is also evidence that Malaysian parents are about equally likely to live with adult children of either sex while Malaysian Chinese are much more likely to live with sons.

II. THE SPREAD OF EDUCATION IN MALAYSIA

The data used in this paper are from the second wave of the MFLS-2.[6] In this section, we use this data to document how education spread through the Malaysian population for three quarters of the century by examining trends in educational attainment by race and sex for cohorts born between 1910 and 1980. As we suspect is true in most other East and Southeast Asian societies, Malaysia has experienced rapid growth in the educational attainment of its population since 1950 and equally rapid erosion of gender differentials in attainment.[7] More surprisingly, we find little evidence of substantial racial differences in education, either before or after the introduction of the N.E.P. in 1970. Finally, the accelerating growth of education in Malaysia has lead to a widening gap between the education of children and their parents. The implications of this intergenerational gap for future patterns of educational change in Malaysia is one of the themes that we discuss in the concluding section of this paper.

Cohort trends in educational attainment in Malaysia by gender and by race for persons born between 1910 and 1980 are presented in Figure 1.[8] The figure presents four panels showing separately for male and female Malays and non-Malays (i.e., Chinese and Indians): (a) the proportion of the cohort entering elementary school; (b) of those who attended elementary school, the proportion who continued to secondary school; (c) of those who attended secondary school, the proportion who entered post-secondary school; and (d) the average years of completed education.[9]

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[6]We describe the data in more detail below in Section 4.

[7]For example, Parish and Willis (1992) find very similar growth in thelevel of education and erosion of gender differentials in retrospective survey data from Taiwan. Unfortunately, generalization to other countries is difficult because readily accessible aggregate cross-national educational data, such as that reported by the World Bank, provides information about the proportion of children in a given age group who are attending school at a moment in time, but no information about the educational attainment of the adult population. Moreover, even attendance data is not available for periods much earlier than the 1950's in most developing countries. Consequently, in these countries historical trends in educational attainment can only be studied with retrospective surveys such as the MFLS surveys.

[8]Figure 1 is based on data on educational attainment, age, race, and sex for all individuals born between 1910 and 1980 for whom either self-reports or second party reports on these variables were available in the MFLS-2 using the "Cohort Sample" described below in Section 4. There are several reasons that members of this sample may not be random samples of their respective cohorts which could lead to bias in cohort trends obtained from retrospective data. In Schoeni, Lillard, and Willis (1993), (in progress), we have investigated two possible sources of bias. One is that secondary reports by a respondent or her spouse about the education of their parents or siblings overrepresent parents or siblings from large families (Preston 1976). Comparison of data from self-reports and secondary reports reveals no systematic difference in either the level or trend of educational acheivement. The second is that racial differentials in education in the MFLS-2 may be influenced by an exodus of well-educated Chinese from Malaysia caused by the N.E.P. policies. MFLS-1 data collected in 1977 reveals that Chinese averaged 1.01 years more than Malays; of those individuals who remained in the MFLS-2 sample in 1988, the differential was .77 years, implying that there was differential attrition of well-educated Chinese. However, even if all attrition were due to migration, our analysis suggests that educational differences by race would be nearly the same as in the total sample. Another potential source of bias in educational trends constructed from retrospective data arises from correlation between mortality and education. Unfortunately, a flaw in the MFLS-2 questionnaire which failed to obtain the date of birth of parents who have died precludes the most straightforward way to investigate this bias.

[9]Censored cohorts who are still attending a given level of school at the time of the survey are omitted from the

The first three of these measures are used in the sequential probit models that are estimated later in the paper.

[Figure 1 about here.]

The dramatic growth of educational attainment in Malaysia together with the virtual disappearance of gender differentials within each racial group for every educational transition is obvious from inspection of Figure 1. During the past sixty years, average years of completed education rose from about two and a half years to over ten years for males while female education grew from only about half a year to about the same level as males for the youngest cohorts. Essentially all of the convergence in the gender differential in education is accounted for by acceleration of the entry of girls into elementary school that appears to have begun before World War II with the cohort of 1930 (see Panel A of Figure 1). By the time of Malaysian Independence in 1958, attainment of some elementary education had become universal. The major factor responsible for growth in years of education for both sexes since independence is the dramatic growth in rate of continuation from elementary to secondary school that appears to have begun after World War II with the cohort of 1940. By the time of the MFLS-2 survey in 1988, more than ninety percent of Malaysian children continued to secondary school. In contrast, the continuation rate from secondary to post-secondary school has remained nearly constant at about twenty percent over the entire sixty year period.

Surprisingly, Figure 1 reveals that the growth of education appears to have followed a very similar pattern across racial groups despite the long history of racial differences in location, occupation, and income and despite the race-specific changes in costs, language of instruction, and access to the education system under the N.E.P. beginning in 1970. The major discernible racial differences are in rates of continuation to secondary school (see Panel B), especially among males. Beginning from a lower base, continuation rates of Malays of both sexes began to grow more rapidly than those of Chinese or Indians after the cohort of 1940, the cohort that reached age 18 in the year of Malaysian independence, reaching equality with the other races for cohorts born in the mid-1950's and surpassing their rates in more recent cohorts. As a result of their more rapid entry into secondary school, Malays have achieved more total years of education upon completion of schooling than non-Malays among cohorts who reached age 12 after 1970 when the N.E.P. policies began (i.e., the birth cohort of 1958). Among 18 year-olds at the time of the MFLS-2 survey (i.e., the birth cohort of 1970), Malays had 10.9 years of schooling compared with 10.2 for Chinese and 9.4 for Indians.

Although we do not see major racial differences in schooling trends, it would be premature to draw the conclusion that the N.E.P. has had little effect because there are so many differences across

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figure.

racial groups in other factors determining educational decisions. Rather, we shall address the question of possible policy effects within the sequential probit analysis reported in Sections V where we are able to control many of the other determinants of education.

III. A SEQUENTIAL CHOICE MODEL OF EDUCATIONAL OUTCOMES

Educational outcomes are discrete levels of attainment, and choices concerning continuing in school are inherently discrete and sequential in nature; i.e., whether to continue to the next grade level or not. The following model of the schooling decisions captures these features. It also incorporates the effects of explanatory variables which may vary by level of education decision, heterogeneity in the probabilities of continuing, and sibling and intergenerational correlation in decisions and outcomes.

We begin with a discussion of the equations for the schooling decisions of a representative person and we explore issues of model specification and estimation. This is followed by a discussion of sibling correlation, intergenerational correlation, and the endogeneity of parents' education as explanatory variables.

A. Educational Attainment of a Representative Individual

We consider four levels of education --- none, elementary, secondary, and post-secondary.

$$s = \begin{cases} 1 & \text{if education is 0 years} \\ 2 & \text{if education is 1 - 6 years} \\ 3 & \text{if education is 7 - 12 years} \\ 4 & \text{if education is more than 12 years} \end{cases} \tag{1}$$

Educational outcomes are assumed to result from up to three sequential decisions. The first decision is whether to attend elementary school (i.e., attend school at all). For those who attended elementary school, the second decision is whether to continue to secondary school or stop in grades 1-6. For those who attended secondary school, the third decision is whether to stop in grades 7-12 or to continue beyond high school.

The model is formulated as a correlated sequential probit model --- a form of discrete hazard with heterogeneity. The probit index function at each decision point, s =1,2,3, for person j is given by

$$W_{sj} = \beta_s' X_{sj} + \delta_j + u_{sj} \tag{2}$$

This equation for the 'propensity to continue' in school includes covariates which vary by individual and by decision level. Some covariates, X_{sj}, such as race and parents education may be constant across decisions while others such as number of male and female siblings, urban/rural residence, and availability of schools my vary by 'schooling level'. In addition, both constant and decision-varying variables may have coefficients, β_s, which differ by level of decision; for

example, from the descriptive statistics in the last section it is clear that the effects of birth cohort differ for the choices of elementary school attendance, for secondary school attendance, and for post-secondary attendance.

Heterogeneity in the propensity to continue in school (assumed to capture all correlation across schooling decisions), is represented by the residual term, δ_j, and is constant across schooling decisions. The remaining residual terms at each decision point, u_{sj}, are then independent of δ_j, and of each other. Both δ_j, and u_{sj}, are assumed to be normally distributed, and the u_s have unit variances. That is, $\delta_j \sim N\left(0, \sigma^2_{\delta_j}\right)$ and $u_{sj} \sim N(0,1)$.

The individual proceeds from grade level s to the next grade level s+1 if $W_{sj} > 0$, so that W_{sj} represents the propensity to continue rather than to drop out. The probabilities of each of the four completed (uncensored) schooling levels for individual j are given by

$$P(S=s) = \begin{cases} P\left[W_{1j} \le 0\right] & \text{if } s=1 \\ P\left[W_{1j} > 0, W_{2j} \le 0\right] & \text{if } s=2 \\ P\left[W_{1j} > 0, W_{2j} > 0, W_{3j} \le 0\right] & \text{if } s=3 \\ P\left[W_{1j} > 0, W_{2j} > 0, W_{3j} > 0\right] & \text{if } s=4 \end{cases} \tag{3}$$

These probabilities of completed schooling levels may be expressed several ways -- in terms of the usual multi-dimensional normal integrals, or, exploiting the variance component error structure, in terms of the integral of conditional probabilities.

B. The 'Usual' Sequential Probit Formulation.

Using the normal stochastic specification and the fact that the sum of two normals is normal $\left(\delta_j + u_{1j}, \delta_j + u_{2j}, \delta_j + u_{3j}\right)$, the probabilities of completed schooling levels become

$$P(S=s) = \begin{cases} \Phi\left(\dfrac{-\beta_1' X_{1j}}{\left(1+\sigma_\delta^2\right)^{1/2}}\right) & \text{if s = 1} \\ \Phi\left(\dfrac{\beta_1' X_{1j}}{\left(1+\sigma_\delta^2\right)^{1/2}}, \dfrac{-\beta_2' X_{2j}}{\left(1+\sigma_\delta^2\right)^{1/2}} \mid \Omega_2\right) & \text{if s = 2} \\ \Phi\left(\dfrac{\beta_1' X_{1j}}{\left(1+\sigma_\delta^2\right)^{1/2}}, \dfrac{\beta_2' X_{2j}}{\left(1+\sigma_\delta^2\right)^{1/2}}, \dfrac{-\beta_3' X_{3j}}{\left(1+\sigma_\delta^2\right)^{1/2}} \mid \Omega_3\right) & \text{if s = 3} \\ \Phi\left(\dfrac{\beta_1' X_{1j}}{\left(1+\sigma_\delta^2\right)^{1/2}}, \dfrac{\beta_2' X_{2j}}{\left(1+\sigma_\delta^2\right)^{1/2}}, \dfrac{\beta_3' X_{3j}}{\left(1+\sigma_\delta^2\right)^{1/2}} \mid \Omega_4\right) & \text{if s = 4} \end{cases} \tag{4}$$

where Φ, in the cumulative normal Probit function and Ω, is the correlation matrix[10]

$$(5)\quad \Omega_2 = \begin{pmatrix} 1 & -\frac{\sigma_\delta^2}{1+\sigma_\delta^2} \\ -\frac{\sigma_\delta^2}{1+\sigma_\delta^2} & 1 \end{pmatrix},\ \Omega_3 = \begin{pmatrix} 1 & \frac{\sigma_\delta^2}{1+\sigma_\delta^2} & -\frac{\sigma_\delta^2}{1+\sigma_\delta^2} \\ \frac{\sigma_\delta^2}{1+\sigma_\delta^2} & 1 & -\frac{\sigma_\delta^2}{1+\sigma_\delta^2} \\ -\frac{\sigma_\delta^2}{1+\sigma_\delta^2} & -\frac{\sigma_\delta^2}{1+\sigma_\delta^2} & 1 \end{pmatrix},\ \Omega_4 = \begin{pmatrix} 1 & \frac{\sigma_\delta^2}{1+\sigma_\delta^2} & \frac{\sigma_\delta^2}{1+\sigma_\delta^2} \\ \frac{\sigma_\delta^2}{1+\sigma_\delta^2} & 1 & \frac{\sigma_\delta^2}{1+\sigma_\delta^2} \\ \frac{\sigma_\delta^2}{1+\sigma_\delta^2} & \frac{\sigma_\delta^2}{1+\sigma_\delta^2} & 1 \end{pmatrix}.$$

The residual structure is essentially a random effects variance component model with up to three replications. However, unlike the continuous variance component model, the outcomes are binary qualitative, and, because decisions are sequential, the number of 'replications' is determined within the model and higher order decisions are made only for positive outcomes at earlier decisions. This is of course a description of the correlated sequential probit model.

From this specification of the model it is clear that decisions are correlated and that subsequent decisions are subject to selectivity with respect to earlier decisions.[11] Incorporation of residual heterogeneity is required to obtain consistent estimates, and to obtain consistent standard errors.

Some individuals may be still enrolled in school, at grade level s, as of the survey date. The probability of censored schooling levels is given by the probability of the grade level of enrollment or higher. For a young person under age seven with no schooling and not attending, there is essentially no information of completed schooling and the likelihood of this event is one ($P(s \geq 1)$). Older individuals with no schooling and not enrolled are assumed to obtain none as a completed outcome. That is, enrollment in schooling level two is equivalent to not stopping at grade one, and enrollment in schooling level three is equivalent to not stopping at levels one or two. Of course enrollment in the highest level is equivalent to attaining that level.

A problem with this formulation is that when correlation is introduced among siblings, with separate components for brothers and sisters, and between parents and their children (boys and girls) the number of cumulative integrals involved becomes very large, increasing for each additional relationship by a multiple of three.

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[10]Probit functions are expressed as cumulative normal integrals, corresponding to the normal variate '$\leq$' some threshold. The change of sign of the all but the last argument in the probit function, and of the last row and column of correlations, is simply an exploitation of the symmetry of the normal density function which allows the probability to be written in one term rather than a longer expression. To use the symmetry of the normal to write probabilities as cumulative integrals, reverse the sign of arguments, and correlations, of any variate involved in a '>' statement.

[11]As a consequence, for example for the decision to attend secondary school,

$$P[s=2 \mid s \geq 2] = \Phi\left(\frac{\beta_1' X_{1j}}{(1+\sigma_\varepsilon^2)^{1/2}}, \frac{-\beta_2' X_{2j}}{(1+\sigma_\varepsilon^2)^{1/2}} \mid \Omega_2\right) \Big/ \Phi\left(\frac{\beta_1' X_{1j}}{(1+\sigma_\varepsilon^2)^{1/2}}\right) \neq \Phi\left(\frac{-\beta_2' X_{2j}}{(1+\sigma_\varepsilon^2)^{1/2}}\right).$$

C. An Alternative Formulation of The Probabilities

Using the fact that the heterogeneity component is constant across educational decisions[12] and the fact that

$$W_{sj} > 0 \;\Leftrightarrow\; \delta_j + u_{sj} > -\beta_s' X_{sj} \;\Leftrightarrow\; u_{sj} > -\left(\beta_s' X_{sj} + \delta_j\right), \tag{6}$$

the multidimensional integrals may be re-written as the product of independent conditional probabilities (on the heterogeneity component) integrated over the unknown heterogeneity component δ_j. Conditional on this component the sequential continuation decisions are independent. The conditional (on δ_j) likelihood of any observed sequence of decisions may be written as

$$L_j^{Ed}(\delta_j) = \begin{cases} \prod_{l=1}^{s-1} \Phi\left(\beta_l' X_{lj} + \delta_j\right) & \text{if Enrolled in Grade s, } s < 4 \\ \Phi\left(-\left(\beta_s' X_{sj} + \delta_j\right)\right) \prod_{l=1}^{s-1} \Phi\left(\beta_l' X_{lj} + \delta_j\right) & \text{if Completed Grade s, } s < 4 \\ \prod_{l=1}^{3} \Phi\left(\beta_l' X_{lj} + \delta_j\right) & \text{if Completed Grade s, } s = 4 \end{cases} . \tag{7}$$

The conditional likelihoods are 'as if' δ_j were known. Since δ_j is unknown, the probability of any particular outcome is given by the 'marginal' likelihood obtained by integrating over the possible values of δ_j

$$L_j^{Ed} = \int_{\delta} \frac{1}{\sigma_\delta} \phi\left(\frac{\delta}{\sigma_\delta}\right) L_j^{Ed}(\delta)\, d\delta \tag{8}$$

where ϕ is the normal density function.[13] This alternative formulation allows more efficient computation algorithms for models incorporating correlation among siblings and between parents and children.

D. Correlation Among Siblings --- Brothers and Sisters

One of the key features of our analysis is the incorporation of correlation in educational outcomes of related family members and testing the potential endogeneity of parents education. The MFLS-2 reports the educational outcomes of virtually all of the living children from sample households. We incorporate both a brother's component, δ_b , and a sister's component, δ_g. We assume that all brothers have the same component, $\delta_j = \delta_b$ for each male sibling j, and that all sisters have the same component, $\delta_k = \delta_g$ for each female sibling k.[14] The brother and sister components are assumed to be jointly normally distributed, with correlation $\rho_{\delta_b \delta_g}$. Implicitly the

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[12] Which generated equal-correlated index function residuals in the previous formulation.

[13] These probabilities are equivalent to those of the previous formulation presented above.

[14] A distinct component unique to each child is also identifiable, *e.g.* $\delta_j = \delta_b + v_{bj}$. However, the increased dimensionality (and thus computational cost) of the integral required for estimation is substantial. This model was estimated empirically, the estimated individual component was relatively small and substantive results were not affected.

model also includes a family component common to all children, male and female, which generates this correlation. Note that while brothers, for example, have the same heterogeneity component, the correlation in their outcomes is not one.[15] The distinction lies in the individual decision specific residuals u_{sj} which are independent across siblings. The correlation in residuals, including both components, is as given by the 'usual' model specification. The correlation in actual schooling outcomes must be computed based on the probability of pairs of sibling outcomes (their joint discrete distribution).[16] The number of brothers and sisters varies from family to family. Let N_b and N_g denote the number of brothers and sisters respectively.

The 'marginal' joint likelihood of the education levels (completed or enrolled) of all $N_c = N_b + N_g$ children from the same family thus may be expressed as

$$L = \int_{\delta_b}\int_{\delta_g} \frac{\phi\left(\frac{\delta_b}{\sigma_{\delta_b}}, \frac{\delta_g}{\sigma_{\delta_g}} \mid \rho_{\delta_b\delta_g}\right)}{\sigma_{\delta_b}\sigma_{\delta_g}} \prod_{j=1}^{N_b} L_j^{E_d}(\delta_{bj}) \prod_{k=1}^{N_g} L_k^{E_d}(\delta_{gk})\, d\delta_b \ldots d\delta_g \tag{9}$$

E. Endogeneity of Father's and Mother's Education

One of the key relationships to be studied is the effects of parents' education on their children. The child's probit index equation is given by

$$W_{sj} = \beta'_{s1} FED_j + \beta'_{s2} MED_j + \beta'_{s3} X_{sj} + \delta_j + u_{sj} \tag{10}$$

where FED_j and MED_j are the potentially endogenous parents' education variables and X_{sj} represents the remaining vector of exogenous covariates. If the unobserved residual components of the child's decision equations, δ_j is correlated with the mother's and father's unobserved residual components, say δ_m and δ_f respectively, then the outcomes of the parents' educational decisions will be correlated with the child's unobserved component, and parents' education variables, *FED* and *MED*, are endogenous.

Mother's and father's education are determined by the same sequential choice model as their children. The mother has a heterogeneity component common with her sisters, say δ_m, and the father has a heterogeneity component common with his brothers, say δ_f, each representing

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[15]Also note that if the model were formulated with a sibling component applying to both male and female children and brother specific and sister specific components (uncorrelated with each other or the sibling component), then the variance of the family component would be the covariance between brothers and sisters in the above specification. The brother and sister components, respectively, would be the difference between the brother variance or sister variance and the covariance between them.

[16]To compute the correlation in schooling outcomes a cardinal value must be assigned to each schooling category.

only one member of their respective families. There are thus two additional heterogeneity components. Empirically, the two components were found to be perfectly correlated (.999),[17] but with different scales reflecting male and female components. Therefore, the model is written with one parent component, δ_p, with unit variance scaled by σ_{δ_b} for the father and by σ_{δ_g} for the mother. The form of the conditional likelihood function for parent outcomes is the same as for the children.

The joint marginal likelihood of parents' and children's outcomes together is obtained by integrating over all heterogeneity components and allowing for parent-child correlation. That is

$$(11) \quad L = \int_{\delta_p}\int_{\delta_b}\int_{\delta_g} \frac{\phi\left(\frac{\delta_p}{1}, \frac{\delta_b}{\sigma_{\delta_b}}, \frac{\delta_g}{\sigma_{\delta_g}} \mid \rho_{\delta_g\delta_b}, \rho_{\delta_g\delta_p}, \rho_{\delta_b\delta_p}\right)}{\sigma_{\delta_b}\sigma_{\delta_g}} L_m^{Pd}(\sigma_{\delta_g}\delta_p) L_f^{Pd}(\sigma_{\delta_b}\delta_p) \prod_{j=1}^{N_b} L_j^{Pd}(\delta_{bj}) \prod_{k=1}^{N_g} L_k^{Pd}(\delta_{gk})\, d\delta_g d\delta_b d\delta_p .$$

Conditional on heterogeneity components, educational decisions of each parent and each child are independent. Correlation in outcomes is due to correlation in the heterogeneity components. Accounting explicitly for the correlation in the estimation procedure also accounts for the endogeneity of parents' education in their children's equations. Failure to account for the correlation, should it be present, would leave unaccounted correlation between the parent's education variables (*FED* and *MED*) and the child's heterogeneity term (δ_b or δ_g) resulting in biased estimates.

Applying this argument recursively, it becomes clear that it is necessary to jointly model the education of all past generations as well. We observe parents' education for three (sometimes four) generations, but the detailed measures of environmental variables can be constructed only for the younger generation. We allow a different (separately reported) set of coefficient estimates for the parents' education equations index functions.[18] Since the parents and children have quite distinct sets of covariate values, their separate equations contain substantial overidentifying information.

F. Estimation

In each of the various models, parameters are estimated by maximum likelihood using iterative methods and analytic derivatives.[19] Integration is performed by a method derived from results in Naylor and Smith (1982).

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[17]The estimated correlation was quite insignificantly different from one by a likelihood ratio test. Recall that perfect correlation in heterogeneity components does not imply perfect correlation in education outcomes.

[18]They are biased because *their* parents education is treated as exogenous.

[19]The software used to implement this model was designed and implemented by Lee Lillard and Constantijn Panis.

IV. DESCRIPTION OF MFLS-2 DATA AND ANALYTIC SAMPLES

The data used in this paper, as noted earlier, are from the MFLS-2 which was conducted in 1988 in a collaborative project between RAND and the National Population and Family Development Board of Malaysia.[20] It provides a rich source of retrospective economic and demographic information about related individuals within families which we exploit in order to analyze historical and intergenerational aspects of the determinants of educational attainment.

The MFLS-2 provides a follow-up to the MFLS-1 which surveyed 1,262 ever married women under age 50 and their husbands during 1976-77. It includes four distinct samples, as follows: (1) The PANEL sample consists of women (together with their current husbands) who were respondents in the MFLS-1, of whom 889 were interviewed (a 72 percent follow-up rate). (2) The CHILD sample is made up of children of PANEL respondents aged 18 or more. Interviews were conducted with one child, selected at random, still living in the household with the PANEL respondent (N = 499), and as many as two children, selected at random, living elsewhere in Peninsular Malaysia (N = 597). (3) The NEW sample consists of women 18-49 in 1988 (regardless of marital status) and ever married women under age 18, (N = 2,184). (4) The SENIOR sample consists of men and women aged 50 or over (N= 1,367), of which 633 lived in the same households as members of the NEW sample.

In this paper, we use the MFLS-2 data from all four of these samples to construct three analytic samples. The first "Cohort Sample" was used in Section II to describe the historical spread of education in Malaysia. To reconstruct the history of Malaysian educational attainment for the maximum feasible span, the Cohort Sample includes everyone in the MFLS-2 about whom we have information on educational attainment, race, sex, year of birth (and/or age), either through a self-report by a female or male respondent about her/himself or from a report by the respondent about other persons who are in the household at the time of the survey and/or who are the respondent's parent or child, regardless of residential status.[21] After eliminating 1) individuals with duplicate reports, 2) individuals whose age is either missing or less than 8 years of age, 3) whose education is missing, 4) whose race is not Malay, Chinese or Indian, and 5) whose sex is not reported, 27,379 individuals remain in the Cohort Sample. The composition of this sample in terms of relationship to the primary respondent is reported in Table 1.

[Table 1 about here]

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[20]See Haaga et al. (1991), for a detailed description of the MFLS-2 and references to the MFLS-1 which was conducted in 1976-77.

[21]It should be noted that we have respondents' reports about parents' educational attainment regardless of whether the parent is still living, but we do not know the parent's year of birth if the parent is not living. However, information on parent education is used to calculate mother's and father's education as explanatory variables in our sequential probit analysis even when the parent is dead.

The other two analytic samples, called the "Children Sample" and the "Parent Sample," are used in the sequential probit analysis which is reported below in Section V. Broadly, the goal of this analysis is to explore family decisions about the schooling transitions of their children, allowing for correlations among siblings and between parents and children, and exploiting retrospective life histories to obtain time-varying explanatory variables. To achieve this goal, the primary focus of the analysis is to estimate the determinants of schooling transitions for individuals in the "Children Sample," who are the children of men and women to whom retrospective life history questionnaires were administered (N = 4794). These respondents, in turn, comprise the "Parent Sample" (N = 1777). In the MFLS-2, life history questionnaires on a variety of topics were administered to female primary respondents from the PANEL sample, to their current husbands, to their sampled adult children in the CHILD sample, to the spouses of these children, to female primary respondents in the NEW sample and to their spouses.[22] The composition of the Children and Parent samples in terms of their relationship to primary female respondents is displayed in the final two columns of Table 1. Note that some individuals may appear in both samples, as the child of a PANEL respondent and as the parent of his or her own child (i.e., the primary respondent's grandchild).

To illustrate the importance of family and intergenerational correlations in schooling outcomes, we report correlations between siblings and parents and their children in Table 2. The greatest correlation, above .5, is between spouses. The next largest correlations, just under .5, are among siblings -- with the weakest being among brothers. The brother-sister correlation is slightly higher than the same-sex sibling correlations. There is also significant correlation between parents and children. The strongest correlation is for mother-daughters and the weakest is for father-sons, with cross-sex correlations being intermediate.

[Table 2 about here]

Life histories of females were obtained on a variety of topics including pregnancies, marriage, migration, work and family background. Similarly, their husbands provide retrospective information on work, migration and family background. As mentioned above, we use information from a parent's life history to help reconstruct the circumstances that influence decisions about a given child's education. For example, a mother's migration history provides information about her location (state and district) and characteristics of her housing (e.g., type of drinking water) at age 15 and the date of each subsequent move together with the location and housing characteristics of the destination. We also know the date of birth of each of her children from her pregnancy history.

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[22]Life history questionnaires for respondents in the SENIOR sample are the same for male and female respondents and are somewhat less detailed than questionnaires received by persons in the other three samples. Children from the SENIOR sample were not included in our analysis because we could not construct time-varying variables for them that are comparable to those that we construct for children of respondents in the other three MFLS-2 samples

Data from these two sources is combined to create time-varying variables which indicate the state and district and characteristics of the house in which each of her children resided when the child was age 6, 12 or 18, the ages at which school transition decisions are assumed to be made. In similar fashion, information from the father's work history can be used to construct time-varying variables measuring his occupation, earnings, etc. Such variables are constructed for each child reported in the mother's pregnancy history who survives to school age.

We present summary statistics for the variables used in the sequential probit analysis in Table 3.

[Table 3 about here]

Panel A summarizes static variables, including parents' education, race, and cohort which are available for members of both the Children and Parent samples. Panel B reports time-varying variables, evaluated at each decision stage, for members of the Children sample. With one exception, discussion of these variables is deferred to the next section so that they can be described in the context of the presentation of our results.

The exception concerns the construction of the school "availability" measures reported in Panel B of Table 1. This measure is developed using a data set containing community characteristics that has been collected as an adjunct to the MFLS-2. The community data contains information about the history of schools in each of the enumeration blocks (EB's) in which respondents resided at the time of the MFLS-2 survey in 1988. In particular, for these EB's, we know the presence and opening date of primary schools for each ethnic group. What we seek is a measure indicating the availability of schools for each child in prior years when the child was age 6, 12 or 18. Unfortunately, while we know the state and district in which the child then resided, we do not know the EB. Within these constraints, we constructed a measure of school availability that varies by time and district. Specifically, we calculated the proportion of sampled EB's within a district that reported having a school of a given type open at a particular point in time. For convenience, we constructed the proportion for each decade represented in the MFLS-2 sample. This was repeated for each type of school. This provides a district-wide measure that can be easily attached to a child's location at each decision point.

V. RESULTS: EFFECTS OF FAMILY, STATE AND SOCIETY

To what extent has the growth in educational attainment and convergence of gender differentials in attainment in Malaysia been a consequence of Malaysia's general economic development and to what extent does it depend on the resources and characteristics of individual families? What role have government policies to increase the availability of schooling played in determining these patterns and to what extent have the race-based policies associated with the N.E.P. resulted in changes in racial differentials in educational

attainment?

A. Empirical Strategy

We address these questions by using the empirical model developed in Section III and data from the Children and Parents Samples described in Section IV. In particular, we attempt to measure significant features of the economic and demographic constraints faced by parents at the time they were making decisions about a given child's education. Thus, the individuals whose educational attainment we seek to explain are the 4794 children of sampled persons who, along with their spouses, answered retrospective life history questionnaires (see Table 1). The restriction to children of sampled persons reduces the range of cohorts analyzed to persons born between 1938–1980 as compared to the broader range of cohorts born between 1910 and 1980 upon which the discussion of trends in educational attainment in Section II is based. However, because our models utilize data on educational attainment of three generations within a given family, the full range of cohorts is represented. Specifically, the education of fathers and mothers of these children are used as explanatory variables and, because parents' education is potentially endogenous, we also estimate equations explaining mother's and father's education as a function of their parents' education. Given the substantial gender differentials discussed earlier, we estimate separate, but correlated, equations for males and females throughout the analysis. Parameters are estimated jointly by maximum likelihood for a system of sequential probit equations for the father, mother, and each son and daughter.

We present estimates of three models of progressively increasing complexity in Table 4. Because even simple models generate a large number of parameter estimates, results in Table 4 are presented in separate panels. In Panels A-F, coefficients of explanatory variables are grouped to correspond to the discussion in subsections 5.2–5.7 below. Intercepts and cohort trends are presented in Panel F. Finally, heterogeneity components together with sibling and parent-child correlations are reported in Panel G.

The three models presented in Table 4 differ both in the number of explanatory variables and in the kinds of intra- and intergenerational correlations among family members that are allowed. In Models 1 and 2, explanatory variables are restricted to an individual's race, sex, cohort, and the education of his or her father and mother. Parents' education is treated as exogenous in Model 1 and as endogenous in Model 2. Finally, Model 3 adds additional time-varying variables measuring family resources and economic and social environment, evaluated at the time each schooling decision was being made (i.e., when the child was 6, 12 or 18 years of age). Such covariates, which are listed in Table 3, include measures of family economic resources (father's and mother's income, occupation, and labor force status); measures of its location and environment (rural-urban location, quality of

drinking water and toilet facilities in the dwelling unit); and measures of its demographic constraints (the number of the child's older and younger brothers and sisters, number of sibs who have died), and the availability of Malay, Chinese, or Tamil language primary schools in the district of residence. As is explained more fully below, after some experimentation we report estimates for only a subset of the available time-varying variables.

In principle, the effects of a given covariate may vary at each decision point. For example, a static variable such as father's education may have little influence on the decision to send a child to elementary school, but might have a large effect on decisions about subsequent transitions to secondary or post-secondary school.[23] Conversely, even though the father's income or the family's place of residence may vary over time, the effect of that variable (i.e., its coefficient) may be approximately the same across the probit index functions associated with each decision stage.[24] After testing the major groups of variables for significant variation across stages, we arrived at the specifications reported in Table 4 in which all variables except race, cohort, and urban residence are constrained to be equal.

B. Heterogeneity and Correlation Among Brothers and Sisters

Important features of our econometric model are the heterogeneity components common to sons and to daughters and the correlation between parents and children. These components are very significant and large in magnitude, as may be seen from Table 5.[25] This implies that there are very important family-related unobserved effects and selection of who progresses through the educational system. The son and daughter components are of roughly the same magnitude—standard deviations of .94 and .84 respectively in the most comprehensive model.[26] They thus account for a little under one-half the variance in the residual at each decision level. The resulting correlation in the total random term across levels of schooling or across siblings is thus .486 and .455 for sons and daughters,

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[23]Using U.S. data, Mare (1980) found, contrary to his theoretical expectations, that the effect of family background variables on schooling transitions weakened as a child progressed through school. He attributed this result to selective attrition on unmeasured individual ability (which was not controlled in his statistical model), although recently Cameron and Heckman (1992) have shown that individual heterogeneity need not result in a progressive weakening of family background effects. We examined the variation in the effect of mother's and father's education across stages in our data, using models with and without allowance for heterogeneity, and found little systematic pattern. As is noted below, we therefore constrained the effects of mother's and father's education to equal for all transitions.

[24]Note that a variable X that has the same probit coefficient in each stage will have different effects on the amount by which the transition probability changes per unit in X to the extent that the level of the transition probability varies by stage. More broadly, it is not clear to us how to formulate meaningful hypotheses about the strengthening or weakening of a variable's coefficient across stages (such as Mare's hypothesis discussed in the preceding footnote) since variation in the effect of a variable across stages is a mixture of behavioral response, the initial level of the transition probability and the functional form of the distribution of unmeasured components.

[25]Taken from Table 4, Panel G, Model 3.

[26]Remember that the correlation in heterogeneity components is one among brothers and among sisters.

respectively. The correlation in heterogeneity components between sons and daughters is a very significant .92 so that the correlation between opposite sex siblings is almost as high as for own sex siblings. The correlation in schooling outcomes[27] predicted by the model for a Malay family with typical characteristics are also presented in Table 5. The relative size of the correlations is the same as the components suggest, but the magnitude of the correlations reflects the presence of the decision-specific residual.[28]

[Table 5 about here]

C. The Role of Parental Education

The effect of parents' education on their children's education is one of the key factors in any consideration of the intergenerational transmission of human capital and economic well-being within families. There are, of course, many possible underlying causal paths that may result in correlation between the schooling of parents and children and the implications of alternative paths for policy may be very different. In particular, we should like to know whether, on the one hand, the correlation arises because parental education has either a direct or indirect effect on the education of children or, on the other hand, whether it arises because of intergenerational correlations of environments or genes which are not causally related to parental education. In the former case, we would like to know more about the underlying causal mechanism. For instance, to what extent does increased parents' education affect child's education because it increases family income and their ability to finance education and to what extent is the effect influenced by quality of time the mother spends with the child or the nature of the father's ambitions for his child's career. In the latter case, we would also like to know more about underlying mechanisms, especially whether they involve variables that could be influenced by policy (e.g., school availability) or not (e.g., smart parents have smart children). Although we do not have enough information to identify all the possible causal channels, consideration of the alternative models that we estimate can provide some clues about the extent to which mothers' and fathers' education have a direct influence on their children's educational attainment and to what extent parental education simply proxies for correlated, but unmeasured economic and demographic factors that influence schooling decisions.

We first examine our empirical results on this transmission process by considering parental education effects over the largest range of cohorts that our data permits. We do this by examining these effects in comparable models estimated in both the Parent and Children

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[27]Using mean schooling levels within our four educational classes to assign cardinal values to the classes.

[28]The magnitude of these correlations is below those of the actual schooling correlations reported in Table 4.2 partly because these are for a particular value of covariates. The high correlation in covariates of members of the same family make the correlations higher.

samples. With parents born in cohorts between 1902 and 1965 and children born between 1938 and 1980, these samples describe educational attainment for almost all cohorts born during the twentieth century.[29]

Because time-varying variables and information about siblings and grandparents are not available for most individuals in the Parent sample, comparable models for the two samples are restricted to the specification in Model 1 in which explanatory variables include only race and cohort in addition to mother's and father's education and parents' education is treated as exogenous.

Results for this specification are presented in Panel A of Table 4 which reports the estimated coefficients of mother's education and father's education in the probit equations for sons and daughters from the Children sample and for fathers and mothers from the Parent sample. Mother's and father's education both have highly significant positive effects on the educational attainment of children of either sex in both the older generations, represented in the parents sample, and the younger generations, represented in the Children sample. Moreover, the father's education coefficients are of similar magnitude in all four equations. In contrast, mother's education clearly has a larger effect on daughters' than on sons' education in both generations. In addition, the impact of mother's education on attainment of both sons and daughters appears to have grown considerably across the two generations. A possible explanation for this is that the growth in schooling received by females (as discussed earlier in Section II) has resulted in an increase in the correlation between a mother's ability and her education in more recent cohorts, thus causing the coefficient of mother's education to increase because it better captures genetic transmission of ability or because it is a better measure of the quality of the mother's time in childrearing.

Next consider the effect of treating mother's and father's education as endogenous in Model 2. Even after accounting for the direct effect of education there are significant positive parent-son and parent-daughter correlations between unmeasured components, as reported in Panel G of Table 4, indicating the potential for bias in estimates of the direct effects of parental education if endogeneity is ignored. Using results presented in the first two rows of Panel A, we may assess the extent of this bias by comparing the coefficients of father's and mother's education on sons' and daughters' education in Models 1 and 2. Although all parental education coefficients remain significant in Model 2, the magnitude of the coefficients for both parents falls by almost 30 percent in the son's equation and by even more in the daughter's equation, where the coefficient of mother's education falls by one-third and of father's education by one-half. Note that the larger decline of parental education

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[29]Some individuals, most of whom are sampled adult children of MFLS1 respondents, are represented twice, once as the son or daughter of the older respondent and once as a parent of the older respondent's grandchildren.

coefficients for daughters relative to sons from Model 1 to Model 2 is mirrored by a higher value of the parent-daughter correlation (about 0.5) relative to the parent-son correlation (about 0.3).

The influence on the direct effects of father's and mother's education of controlling for time-varying covariates measuring the household's economic situation, location, environment, and composition of the sibset can be seen by comparing Model 3 with Model 2 in Panel A. For sons, the direct effects of father's and mother's education each decrease in magnitude by about half in Model 3, with the father's coefficient becoming marginally significant and the mother's insignificant. For daughters, the estimated effect of father's education falls to near zero and to statistical insignificance while the effect of mother's education remains highly significant, although it falls in magnitude by about 30 percent when these covariates are added. In all, the results from Model 3 suggest that father's and mother's education have about equal effects on the education of sons, but only mother's education affects the education of daughters.

Three summary conclusions emerge from this analysis of parental education effects. First, at least two-thirds of the impact of parental education on their childrens' schooling transitions appears to be a direct consequence of parent schooling while the remaining one-third can be attributed to unmeasured factors that influence educational attainment of both parents and children. Second, it appears that the direct effects of a parent's education predominantly influence children of the same sex. Moreover, the direct effect of mother's education on her daughter's education is somewhat stronger than the direct effect of father's education on his son's education. Finally, the introduction of measured time-varying economic and demographic factors weakens the direct effects of parental schooling, especially father's education, but does not weaken the correlation of unmeasured components between parents and children. These results are consistent with a hypothesis that the direct effect of father's education stems primarily from its impact on the economic resources and location of the family whereas the direct effect of mother's education is associated with non-market factors such as the quality of time she spends with children.

D. Father's and Mother's Economic Characteristics

A number of time-varying measures of the economic status of a child's mother and father at the time a given schooling decision was being made can be derived from information contained in the work history questionnaires of male and female respondents who are parents of the child in question. Such variables include measures of occupation, work status, earnings, and labor supply. In this paper, we only utilize variables based on the father's occupation since other variables based on father's current earnings and his work status were insignificant as were all variables for the mother, including those based on her

occupation. Specifically, we use the father's two-digit occupation to construct two variables for each decision point . One is a dummy variable indicating whether the father is a farmer or farm laborer and the other is a variable measuring the log of the mean earnings in the father's occupation based on a post-enumeration survey of the 1970 Malaysia Census as reported in Anand (1983, Table 6–11). We interpret the occupational earnings variable as a measure of a component of a father's permanent earnings.

Results for these two variables are reported in Panel B of Table 4 for Model 3. Unsurprisingly, a child whose father is a farmer will be less likely to enter school or continue to a higher level, especially if the child is a girl. The coefficients for father's occupational earnings are of opposite sign for sons and daughters, but are insignificant and of very small magnitude.

In terms of theoretical issues discussed in the Introduction, the lack of strong or significant effects of father's earnings is consistent with the perfect capital market version of the Becker-Tomes model which predicts that optimal investment is independent of parental income when factors affecting the returns to education are held constant. A more cautious interpretation is that the lack of significance of these variables simply reflects our inability to reconstruct the family's economic situation sufficiently accurately from retrospective data.

E. Effects of Size and Composition of the Sibset

There are a number of ways in which the educational attainment of a given child may be influenced by the number, age, activities (i.e., attending school or not), and location (i.e., in or out of household) of his or her brothers and sisters. As we discussed in the Introduction, additional siblings may have their primary effect by competing for parental time and money resources. For a given family size, it is possible that older children may subsidize the education of younger siblings by contributing to the family time or money budget. Moreover, as is suggested by the "Greenhalgh hypothesis," the net cost or contribution of a sibling to the education of a given child may depend on the sex and birth order of both the child and the sibling. In particular, as discussed in the Introduction, Greenhalgh (1985) suggests that older sisters in Taiwan help finance the education of their younger brothers while Parish and Willis (1992) find that older sisters appear to help both younger brothers and younger sisters.

We experimented with several simpler specifications of sibling effects than the one reported in Panel C of Table 4. In these experiments we found support for the hypothesis that siblings compete for parental resources. In particular, the number of siblings significantly reduces schooling for both boys and girls. When siblings are distinguished by gender, we find that competition is largely with siblings of the child's own sex. In the specification reported in Panel C, we distinguish between older and younger siblings of the

same sex. While all sibling variables have negative signs, the only significant effects are the number of older brothers of boys and the number of younger sisters for girls. These results are not inconsistent with the Greenhalgh hypothesis in the sense that, holding total family size constant, a boy's education would be helped if he had one less older brother and one more older sister, but are inconsistent with Parish and Willis because a girl's education would be slightly reduced by such an experiment. In addition, in estimates not reported, we failed to find significant differences between the effects of older and younger siblings of the opposite sex, nor do we find that these effects are significant when they are estimated separately for Chinese families.

F. Place of Residence

We have attempted to capture some aspects of the broader environment in which family schooling decisions were made by entering time-varying variables to measure the quality of its residential environment, the availability of primary schools for each ethnic group, and whether the household resided in an urban place. The quality of the residential environment is measured by an index constructed from information on how "modern" were the water and waste disposal facilities in the home in which the child lived when he or she was 6, 12, or 18.[30] Although this variable, to some extent, may be associated with family wealth or with the health of the child, we have grouped it with other environmental variables because of its likely relationship to the modernity of the local infrastructure. The school availability variables, also described in Section IV, attempt to measure the likelihood that a Malay, Chinese, or Tamil-language primary school is available near the child's place of residence at each of these decision points. These availability variables are interacted with the child's race so that it is assumed that only schools providing instruction in the child's native language influence the schooling decision.[31] Finally, we note that "urban" was found to have significantly different effects for the different school transition decisions, so that separate coefficients are required.

As shown in Panel D of Table 4, all significant coefficients of the "environmental" variables are positive. Specifically, quality of the residential environment has a positive

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[30]The index is constructed as follows. First, three dummy variables are constructed which are, respectively, equal to one if the house has piped drinking water, uses piped water for washing, and has flush toilets and equal to zero otherwise. These variables are summed and the sum is divided by three to yield an index which is equal to one if all facilities are modern and to zero if all are not modern.

[31]In preliminary analysis in which we estimated separate probits for each race, we found that availability of primary schools in other than the child's native language were not significant. We also attempted to use a measure of the availability of secondary schools (for which the language of instruction is not available), but this was never significant. Since the primary school measures performed in a similar fashion across transition decisions at all levels including continuation to secondary and post-secondary as well as entry into primary school, we suspect that these measures are correlated with the availability of ethnic-specific schools at the secondary level.

effect on the education of both boys and girls, but the effect is significant only for boys. The school availability measures are highly significant for Chinese of both sexes. Although they are also positive for Malays, the availability measures are marginally significant only for boys and, for Indians, the coefficients are of mixed signs and insignificant. Urban residence has highly significant effects on transitions to secondary and post-secondary school for both sons and daughters, but no significant effect for entry into elementary school. The latter finding probably reflects the fact that elementary schooling is nearly universal throughout Malaysia for these cohorts, while former findings may reflect the tendency for the returns to secondary and post-secondary education to be the highest in urban areas. Interestingly, the coefficients of urban residence are nearly twice as large for continuation to secondary school as they are for continuation to post-secondary school. A possible reason is that attendance at post-secondary school is less tied to the residential location of the student's family.

G Racial Differences and the Effects of the N.E.P. Policy

One of the most interesting questions posed by recent Malaysian history is whether the N.E.P. policy and related race-based government policies that we discussed in the Introduction have influenced racial differentials in educational attainment in recent cohorts. We have already seen that the availability of Chinese-language schools appears to have a significant impact on the schooling of children from Chinese families. Since one of the goals of government policy since 1970 is to make Malay the universal language of instruction, the elimination or reduction of the availability of Chinese language schools might be expected to shift racial differentials in educational attainment in favor of Malays.

The pattern of racial differentials, and how it is affected by controls for other variables, can be discerned from the coefficients on dummy variables for Chinese and Indians that are presented in Panel E of Table 4. We found that the race coefficients varied across the different stages of schooling so that separate effects for elementary, secondary and post-secondary transitions are estimated. Race coefficients are reported for the equations determining educational transitions of fathers and mothers as well as the equations for sons and daughters for all three model specifications (Models 1–3).

To interpret these results it is important to note that most individuals in the Parent sample generation received their educations before 1970 when the N.E.P. was introduced or even before Malaysia attained independence in 1958. In contrast, the great majority of the individuals in the Children sample entered school after 1970 (i.e., were born after 1964) and only a minority, born before 1958, made the decisions about secondary school before the advent of the N.E.P. In the older cohort of fathers and mothers, most of the race dummies are positive, indicating a disadvantage for Malays, but the only strongly significant effects are for the transition to secondary school in the fathers equation, and none of the race coefficients

are significant in the mothers equation (see Panel E, Model 1, Fathers and Mothers Equations).[32] This picture is changed to a considerable extent in the comparable equations for sons and daughters for Model 1. First, Malay males are no longer at a disadvantage relative to Chinese or Indians in secondary school entry. Second, a Malay advantage emerges among males for the transition to post-secondary school and among females for both secondary and post-secondary transitions.[33]

The relative gains experienced by Malays that we see from these cross-cohort comparisons are compatible with the hypothesis that the N.E.P. has played a role in eliminating or even reversing racial differentials in educational attainment, but they hardly prove the case. An additional bit of supporting evidence is provided by comparing the race coefficients in the sons and daughters equations in Model 2, which controls only for parental education and cohort, with those in Model 3, which includes the full set of explanatory variables. This comparison reveals a fairly clear pattern showing that the Malay advantage tends to grow (or disadvantage to diminish) as we add covariates and thus control for more factors, other than race, which influence schooling decisions. If the primary reason for racial differentials is that, on average, Malay families have poorer opportunities (e.g. fewer parental resources, more rural, less access to schooling) than Chinese or Indian families, we would expect to see the opposite pattern. That is, the addition of controls for residence and school availability would tend to reduce the size of the race coefficients by controlling for differences in educational opportunities among the groups. However, if Malays benefit from lower tuition and easier promotion and admission standards under the N.E.P. policy, then control for "opportunity factors" will tend to increase the estimated Malay advantage. This is the pattern we see.

We have also attempted to see whether there are racial differences in cohort trends that might be attributed to the impact of government policy. For example, we interacted the race dummies with a dummy variable indicating whether a given schooling decision was made after 1970, the year in which the N.E.P. was instituted. These coefficients were insignificant. We also experimented with race-specific splines on cohort trends in the sons and daughters equations to test for more gradual effects of the N.E.P. Again, differences across the races were insignificant. In the specifications reported in Panel F.1 of Table 4, cohort trends for the Children sample are linear for each decision stage and independent of

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[32]There are only minor variations across Models 1–3 in the race coefficients in the parents' equations because the explanatory variables in these equations (but not in the sons and daughters equations) are same in all three models. Therefore, we consider only the coefficients for Model 1.

[33]The Chinese dummy for entry into elementary schools in the daughters equation is positive, significant, and much larger than the corresponding coefficient in the mothers equation. We have no explanation for this anomalous result.

race except for the transition to secondary school which allows for differential trends for Malays and non-Malays (i.e., Chinese or Indians). Although the latter coefficients indicate more rapid growth for Malay males since the cohort of 1938, the differential between Malays and non-Malays is not statistically significant. Thus, an examination of cohort trends in schooling transitions provides no further evidence of the impact of government policy on racial differences in education.

VI. SUMMARY AND CONCLUSIONS

This paper explores the impact of family, state and society on the intergenerational transmission of education in a rapidly developing, multi-racial society using data from the MFLS-2. Using this data to reconstruct the historical record of the spread of education in Malaysia during much of this century, we find that educational attainment has increased more than five fold to about 10 years of education and that gender differentials had essentially disappeared by the time the MFLS-2 was fielded in 1988. The question of racial differences in education is of special interest in Malaysia where the majority ethnic group, the Malays, are poorer and more agrarian than the Chinese and Indian minorities. Since achieving independence in 1957, the Malay-dominated government has aggressively pursued both general development of the nation's educational system and a set of education and employment policies explicitly favoring Malays, most notably in the N.E.P. begun in 1970. In view of these policies, the historical pattern of the spread of education is remarkably similar across racial groups both before and after independence and the introduction of the N.E.P. policies.

These broad societal developments provide the context for a micro-level empirical analysis of family-influenced schooling decisions using a dynamic sequential choice model of entry into elementary school and subsequent transitions to secondary and post-secondary school. A major strength of the MFLS-2 data is that it contains information on the educational attainment of three generations of individuals within a given family. The sequential choice model exploits this strength by allowing us to estimate equations for the schooling decisions of all children within a family jointly, allowing for correlations of unmeasured components among siblings and between parents and children. The fact that we have information on the education of grandparents enables us to treat the effect of mother's and father's education on their children's schooling as endogenous, thereby permitting us to distinguish the direct and indirect effects of parents' education. We also exploit another strength of the data, its retrospective life histories, to generate time-varying variables which attempt to capture the effects of environmental factors and family-specific economic and demographic constraints at the time schooling decisions were made.

One set of issues that we address with our sequential choice model involves questions concerning intergenerational mobility in educational attainment and the extent to which parental

education plays a direct or indirect role in the transmission of educational attainment across generations. As is true in most studies of background effects on educational attainment, we find that mother's and father's education have positive and significant effects on their children's educational attainment. Our data and model permit us to explore some of the underlying reasons for this correlation. In particular, we find that at least two-thirds of the impact of parental education on their childrens' schooling transitions appears to be a direct or indirect consequence of parent schooling, while the remaining one-third can be attributed to unmeasured factors that influence educational attainment of both parents and children. In addition, we find that the introduction of measured time-varying economic, demographic and environmental factors weakens the direct effects of parental schooling, especially father's education, but does not weaken the correlation of unmeasured components between parents and children. While we were unable to obtain precise estimates of the effects of family economic variables on schooling, we did find that family environments, measured by housing quality, school availability and urban residence, had significant positive effects on schooling.

Although gender differentials in educational attainment have virtually disappeared in Malaysia, we do find some consistent patterns of sex differences at the family level. In particular, mother's education has a relatively stronger impact on daughters while father's education has a larger impact on the education of sons. Moreover, we find that siblings of the same sex appear to be rivals in attracting investment of resources from their parents in the sense that a given girl's education is reduced the more sisters she has and, similarly, a boy's schooling is reduced by the presence of additional brothers. Girls are more handicapped than are boys by residing in a rural household, especially if the father is a farmer. Finally, the correlation of unmeasured family components is stronger between parents and daughters than it is between parents and sons.

We find some indirect evidence that government policies favoring Malays have reduced or even reversed the traditional pattern of higher levels of educational attainment among Chinese and Indians than in the Malay majority. However, we have been unable to demonstrate that the timing of changes in schooling decisions by families in the different ethnic groups coincided with major changes in policy. Perhaps this simply reflects the fact that race-based policies have been in place since Malaysian independence, that the N.E.P. is only one aspect of such policies, and that the content of the N.E.P. itself has been evolving over time.[34] With the data available to us, it is difficult to see how to pin down the policy effects any more firmly. On the other hand, one clear message from our analysis is that the most significant aspects of educational progress in Malaysia is shared by all races. In particular, the rapid growth in the level of education and the elimination of gender differentials has been common to all Malaysians.

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[34]This is essentially the conclusion argued by Pong (1992) in an analysis of transitions to secondary school

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Table 1.

Distribution of Analytic Samples by Relationship to Primary Respondent

Relationship To Primary Respondent	(a) COHORT SAMPLE Obs.	Mean Cohort	(b) CHILDREN SAMPLE Obs.	Mean Cohort	(c) PARENT SAMPLE Obs.	Mean Cohort
Father	1258	27.7				
Mother	1952	30.8				
Spouse's Father	751	24.9				
Spouse's Mother	1239	28.3				
Primary Respondent	3425	49.6			855	41.5
Respondent's Spouse	2607	45.2			714	36.8
Brother	1115	60.8				
Sister	821	60.4				
Spouse's Brother	288	51.0				
Spouse's Sister	354	52.5				
Child's Father-Inlaw	266	29.3				
Child's Mother-Inlaw	358	33.5				
Son	4596	66.7	2169	66.2	143	54.6
Daughter	4503	66.7	2127	65.8		
Son-Inlaw	405	54.2				
Daughter-Inlaw	338	59.6				
Grandson	397	74.6	266	75.7		
Granddaughter	355	75.1	232	76.3		
Senior Male Respondent	309	27.9				
SMR Wife	245	36.8				
SMR Son	878	61.6				
SMR Daughter	785	61.4				
SMR Father	1	16.0				
SMR Mother	2	10.0				
SMR Brother	3	48.3				
SMR Sister	1	40.0				
SMR Grandson	38	73.5				
SMR Granddaughter	33	74.9				
SMR Son-Inlaw	13	58.8				
SMR Daughter-Inlaw	43	58.3				
Total	27379	52.6	4794	67.1	1777	41.2

Note: SMR is senior male respondent from the SENIOR sample. All other primary respondents are female.

Table 2.

Empirical Correlations in Level of Education

	Fathers	Mothers	Sons	Daughters
Fathers		.5367	.1938	.2255
Mothers			.2390	.3582
Sons			.4311	.5036
Daughters				.4881

Table 3.

Means and Standard Deviations of Explanatory Variables
(Standard Deviations in Parentheses)

A. STATIC VARIABLES

	Children Sample (N = 4794)	Parent Sample (N = 1777)
Mother's Education (med)	2.9249 (3.4321)	1.2378 (2.3468)
Father's Education (fed)	4.7923 (3.2229)	3.6401 (3.0721)
Father's Ed Missing (fedmiss)	0.1842 (0.3877)	0.2431 (0.4291)
Father Non-respondent (dadmiss)	1.2374 (0.4255)	
Chinese	0.3106 (0.4628)	0.3157 (0.4649)
Indian	0.1189 (0.3237)	0.1165 (0.3209)
Birth Cohort (cohort)	67.0557 (8.7860)	41.1947 (10.2297)

(continued)

Table 3. (continued)

B. TIME-VARYING VARIABLES IN CHILDREN SAMPLE

	Age 6 (N = 4794)	Age 12 (N = 4009	Age 18 (N = 2897)
Log Father's Occ. Earnings (dlogo)	4.8632 (0.9278)	4.5704 (1.1133	3.9503 (1.6206)
Father Farmer/Farm Laborer (dfarm)	0.3031 (0.4596)	0.2881 (0.4529)	0.2710 (0.4445)
Number of Siblings (numsib)	4.0601 (2.2676)	5.1242 (2.3276)	5.7739 (2.4383)
Number of Brothers (numbro)	2.0413 (1.5211)	2.5989 (1.6137)	2.9285 (1.6911)
Number of Sisters (numsis)	2.0188 (1.5545)	2.5253 (1.6587)	2.8454 (1.7373)
Number of Older Brothers (nob)	1.2393 (1.4061	1.2215 (1.3962)	1.1533 (1.3418)
Number of Younger Brothers (nyb)	0.8020 (0.8111)	1.3774 (1.1839)	1.7753 (1.4298)
Number of Older Sisters (nos)	1.2651 (1.4360)	1.2539 (1.4352)	1.1819 (1.3669)
Number of Younger Sisters (nys)	0.7537 (0.8333)	1.2714 (1.2078)	1.6634 (1.4720)
Index of Modernization (mod)	0.6192 (0.4091)	0.6459 (0.4072)	0.6579 (0.4073)
Malay Language Schools*Malay (scha-m)	0.2564 (0.3735)	0.2668 (0.3807)	0.2828 (0.3867)
Chinese Language School*Chinese (ssha-c)	0.0427 (0.1483)	0.0491 (0.1583)	0.0538 (0.1734)
Tamil Language School*Indian (scha-i)	0.0115 (0.0696)	0.0129 (0.0781)	0.0137 (0.0836)

Table 4, Panel A.

Effects of Parental Education on Schooling Progression Probabilities

	Model 1		Model 2		Model 3	
	Male	Female	Male	Female	Male	Female
			Sons and Daughters Education Attainment			
Mother's Education	0.0910 ***	0.1635 ***	0.0656 ***	0.1083 ***	0.0352	0.0770 ***
	(0.0165)	(0.0185)	(0.0210)	(0.0214)	(0.0243)	(0.0231)
Father's Education	0.1052 ***	0.0880 ***	0.0756 ***	0.0445 **	0.0415 *	0.0140
	(0.0176)	(0.0207)	(0.0214)	(0.0226)	(0.0240)	(0.0226)
Father's Education Missing	0.2367 **	0.0118	0.1655	-0.0599	0.2082	0.0834
	(0.1058)	(0.1129)	(0.1137)	(0.1162)	(0.1897)	(0.1611)
Father Nonrespond					-0.1329	-0.2802
					(0.2142)	(0.2080)
			Father and Mother Education Attainment			
Mother's Education	0.0545 **	0.1151 ***	0.0488 *	0.1097 ***	0.0523 **	0.1044 ***
	(0.0258)	(0.0233)	(0.0255)	(0.0230)	(0.0264)	(0.0226)
Father's Education	0.0945 ***	0.0886 ***	0.0942 ***	0.0838 ***	0.0966 ***	0.0788 ***
	(0.0222)	(0.0183)	(0.0226)	(0.0178)	(0.0234)	(0.0170)
Father Nonrespond	-0.0604	-0.1483	-0.0466	-0.0907	-0.0719	-0.0897
	(0.1394)	(0.1262)	(0.1411)	(0.1249)	(0.1453)	(0.1217)

Notes: a. All parameters in Table 4, Panels A-G jointly estimated by MLE.
b. Significance levels (2-tail) denoted by * =.10, ** =.05, *** =.01.

Table 4, Panel B.

Effects of Father's Occupation on Schooling Progression Probabilities

	Model 1		Model 2		Model 3	
	Male	Female	Male	Female	Male	Female
Log Fthr Occ Earn					-0.0107	0.0170
					(0.0283)	(0.0299)
Fthr Farmr/Farm Lbr					-0.2082 *	-0.3936 ***
					(0.1140)	(0.1048)

Notes: a. All parameters in Table 4, Panels A-G jointly estimated by MLE.
b. Significance levels (2-tail) denoted by * =.10, ** =.05, *** =.01.

Table 4, Panel C

Effects of Siblings on Schooling Progression Probabilities

	Model 1		Model 2		Model 3	
	Male	Female	Male	Female	Male	Female
No of Brothers						-0.0230 (0.0290)
No of Older Brothers					-0.1144 *** (0.0346)	
No of Youngr Brothers					-0.0476 (0.0370)	
No of Sisters					-0.0070 (0.0289)	
No of Older Sisters						-0.0427 (0.0316)
No of Younger Sisters						-0.0735 ** (0.0322)

Notes: a. All parameters in Table 4, Panels A-G jointly estimated by MLE.
b. Significance levels (2-tail) denoted by * =.10, ** =.05, *** =.01.

Table 4, Panel D.

Effects of Family Environment on Schooling Progression Probabilities

	Model 1		Model 2		Model 3	
	Male	Female	Male	Female	Male	Female
Housing Quality and School Availability						
Index of Modernization					0.2306 **	0.0913
					(0.1170)	(0.1152)
Malay Language Schools*Malay					0.3026 *	0.1789
					(0.1591)	(0.1413)
Chinese Language Schools*Chinese					1.1453 ***	1.1155 ***
					(0.3674)	(0.3279)
Tamil Language School*Indian					0.6174	-0.3516
					(0.8955)	(1.0348)
Urban Residence, By Decision Level						
To Elementary School						
Urban					-0.3957	0.1969
					(0.3068)	(0.2569)
To Secondary School						
Urban					0.8438 ***	0.9018 ***
					(0.1698)	(0.1451)
To Post-Secondary School						
Urban					0.4149 **	0.5942 ***
					(0.1683)	(0.1647)

Notes: a. All parameters in Table 4, Panels A-G jointly estimated by MLE.
b. Significance levels (2-tail) denoted by * =.10, ** =.05, *** =.01.

Table 4, Panel E

Effects of Ethnicity on Schooling Progression Probabilities by Schooling Decision Level

	Model 1		Model 2		Model 3	
	Male	Female	Male	Female	Male	Female
			Sons and Daughters Education Attainment			
			To Elementary School			
Chinese	0.2860	0.4692 **	0.3100	0.5110 **	0.2779	0.2938
	(0.2265)	(0.2064)	(0.2477)	(0.2114)	(0.2823)	(0.2258)
Indian	0.2692	-0.0395	0.3992	0.0988	0.5682	0.0780
	(0.4342)	(0.2453)	(0.4691)	(0.2808)	(0.5848)	(0.2978)
			To Secondary School			
Chinese	0.0090	-0.2878	0.0544	-0.2507	-0.2560	-0.6246 ***
	(0.1844)	(0.2029)	(0.1995)	(0.2059)	(0.2393)	(0.2346)
Indian	-0.1971	-0.4953 **	-0.0814	-0.3841	-0.2220	-0.5151 *
	(0.1948)	(0.2372)	(0.2077)	(0.2472)	(0.2617)	(0.2762)
			To Post-Secondary School			
Chinese	-0.5072 ***	-0.3960 ***	-0.4669 ***	-0.3547 **	-0.6730 ***	-0.7024 ***
	(0.1258)	(0.1422)	(0.1344)	(0.1461)	(0.1927)	(0.1870)
Indian	-0.6986 ***	-0.9604 ***	-0.6052 ***	-0.7954 ***	-0.6477 **	-0.8978 ***
	(0.1951)	(0.2400)	(0.2208)	(0.2380)	(0.2601)	(0.2821)
			Father and Mother Education Attainment			
			To Elementary School			
Chinese	0.2541	0.0790	0.2828	0.0936	0.2657	0.0818
	(0.1958)	(0.1455)	(0.1947)	(0.1386)	(0.2008)	(0.1326)
Indian	0.6634 *	0.2319	0.6287	0.2496	0.6661 *	0.2250
	(0.3939)	(0.1991)	(0.3857)	(0.1954)	(0.4003)	(0.1928)
			To Secondary School			
Chinese	0.7185 ***	0.0785	0.7428 ***	0.0836	0.7461 ***	0.0673
	(0.1969)	(0.1899)	(0.1958)	(0.1881)	(0.2032)	(0.1815)
Indian	0.9937 ***	-0.1754	1.0125 ***	-0.1675	1.0181 ***	-0.1888
	(0.2665)	(0.2496)	(0.2629)	(0.2459)	(0.2710)	(0.2378)
			To Post-Secondary School			
Chinese	-0.3039	-0.5793	-0.2552	-0.5395	-0.2447	-0.5473
	(0.4290)	(0.4649)	(0.4301)	(0.4574)	(0.4399)	(0.4411)
Indian	0.4073	-0.5812	0.4005	-0.6423	0.4069	-0.6221
	(0.5278)	(0.5559)	(0.5328)	(0.5331)	(0.5500)	(0.5158)

Notes: a. All parameters in Table 4, Panels A-G jointly estimated by MLE.
b. Significance levels (2-tail) denoted by * =.10, ** =.05, *** =.01.

Table 4, Panel F.1

Intercepts and Effects of Birth Cohort on Schooling Progression Probabilities by Schooling Decision Level

	Model 1		Model 2		Model 3	
	Male	Female	Male	Female	Male	Female
	Sons and Daughters Education Attainment					
	To Elementary School					
Intercept	2.0707 ***	1.2970 ***	2.2630 ***	1.5677 ***	2.4945 ***	1.7405 ***
	(0.1986)	(0.1596)	(0.2104)	(0.1755)	(0.2625)	(0.2474)
Cohort	0.0242 ***	0.0487 ***	0.0257 ***	0.0517 ***	0.0326 ***	0.0533 ***
	(0.0086)	(0.0083)	(0.0088)	(0.0085)	(0.0118)	(0.0102)
	To Secondary School					
Intrcept	-0.3805 ***	-1.0836 ***	-0.1890	-0.7879 ***	-0.1504	-0.5447 **
	(0.1322)	(0.1519)	(0.1475)	(0.1622)	(0.2435)	(0.2425)
Birth Cohort-Malay	0.0777 ***	0.1068 ***	0.0796 ***	0.1097 ***	0.0923 ***	0.1109 ***
	(0.0078)	(0.0086)	(0.0080)	(0.0091)	(0.0094)	(0.0104)
Birth Cohort-Chinese	0.0610 ***	0.0970 ***	0.0619 ***	0.0991 ***	0.0759 ***	0.1017 ***
	(0.0098)	(0.0097)	(0.0108)	(0.0100)	(0.0129)	(0.0113)
	To Post-Secondary School					
Intercept	-2.2976 ***	-3.1138 ***	-2.1431 ***	-2.8343 ***	-2.1283 ***	-2.5191 ***
	(0.1431)	(0.1861)	(0.1626)	(0.2041)	(0.2827)	(0.3246)
Cohort	0.0493 ***	0.0916 ***	0.0524 ***	0.0975 ***	0.0647 ***	0.0992 ***
	(0.0073)	(0.0103)	(0.0075)	(0.0107)	(0.0095)	(0.0131)

Notes: a. All parameters in Table 4, Panels A-G jointly estimated by MLE.
b. Significance levels (2-tail) denoted by * =.10, ** =.05, *** =.01.

Table 4, Panel F.2

Intercepts and Effects of Birth Cohort on Schooling Progression Probabilities by Schooling Decision Level

	Model 1		Model 2		Model 3	
	Male	Female	Male	Female	Male	Female
			Father and Mother Education Attainment			
			To Elementary School			
Intercept	1.7298 ***	0.8788 ***	1.7389 ***	0.8623 ***	1.7617 ***	0.8235 ***
	(0.2031)	(0.1430)	(0.2005)	(0.1394)	(0.2074)	(0.1352)
Birth Cohort <50	0.0535 ***	0.1077 ***	0.0553 ***	0.1066 ***	0.0565 ***	0.1016 ***
	(0.0099)	(0.0099)	(0.0098)	(0.0094)	(0.0101)	(0.0091)
Birth Cohort >50	0.0437	0.0467 *	0.0459	0.0455 *	0.0473	0.0428 *
	(0.1555)	(0.0271)	(0.1539)	(0.0263)	(0.1582)	(0.0253)
			To Secondary School			
Intercept	-1.2552 ***	-1.6892 ***	-1.2122 ***	-1.6125 ***	-1.2300 ***	-1.5030 ***
	(0.2035)	(0.1790)	(0.2037)	(0.1761)	(0.2102)	(0.1709)
Birth Cohort <50	0.0667 ***	0.0743 ***	0.0709 ***	0.0774 ***	0.0719 ***	0.0720 ***
	(0.0108)	(0.0188)	(0.0110)	(0.0186)	(0.0115)	(0.0181)
Birth Cohort >50	0.0179	0.0878 ***	0.0147	0.0823 ***	0.0141	0.0771 ***
	(0.0691)	(0.0244)	(0.0699)	(0.0242)	(0.0719)	(0.0232)
			To Post Secondary School			
Intercept	-2.4706 ***	-2.7587 ***	-2.4450 ***	-2.6243 ***	-2.4811 ***	-2.4180 ***
	(0.4013)	(0.4024)	(0.4106)	(0.3927)	(0.4252)	(0.3795)
Birth Cohort <50	0.0007	0.0469	0.0075	0.0534	0.0112	0.0477
	(0.0255)	(0.0369)	(0.0261)	(0.0353)	(0.0273)	(0.0345)
Birth Cohort >50	0.1594	-0.0370	0.1531	-0.0421	0.1513	-0.0433
	(0.1162)	(0.0775)	(0.1165)	(0.0756)	(0.1156)	(0.0729)

Notes: a. All parameters in Table 4, Panels A-G jointly estimated by MLE.
b. Significance levels (2-tail) denoted by * =.10, ** =.05, *** =.01.

Table 4, Panel G

Residual Heterogeneity Components and Correlations, Log Likelihood

	Model 1	Model 2	Model 3
		Male, Female Heterogeneity Components	
Male: σ_{δ_b}	0.8921 ***	0.9274 ***	0.9450 ***
	(0.0406)	(0.0593)	(0.0710)
Female: σ_{δ_g}	0.9527 ***	0.9494 ***	0.8356 ***
	(0.0387)	(0.0591)	(0.0638)
		Correlations Across Components - Sons, Daughters, Parents	
$\rho_{\delta_b\delta_g}$		0.3203 ***	0.4125 ***
Son-Dau		(0.0990)	(0.1073)
$\rho_{\delta_g\delta_p}$		0.4909 ***	0.5453 ***
Parent-Son		(0.0960)	(0.1105)
$\rho_{\delta_b\delta_g}$	0.8823 ***	0.9193 ***	0.9176 ***
Parent-Dau	(0.0439)	(0.0456)	(0.0531)
LOG LIK	-4365.4	-4357.8	-4276.1

Notes: a. All parameters in Table 4, Panels A-G jointly estimated by MLE.
b. Significance levels (2-tail) denoted by * =.10, ** =.05, *** =.01.

Table 5

Predicted Correlations in Level of Education

	Fathers	Mothers	Sons	Daughters
Fathers		.3601	.1136	.1701
Mothers			.1140	.1737
Sons			.3468	.2795
Daughters				.2895

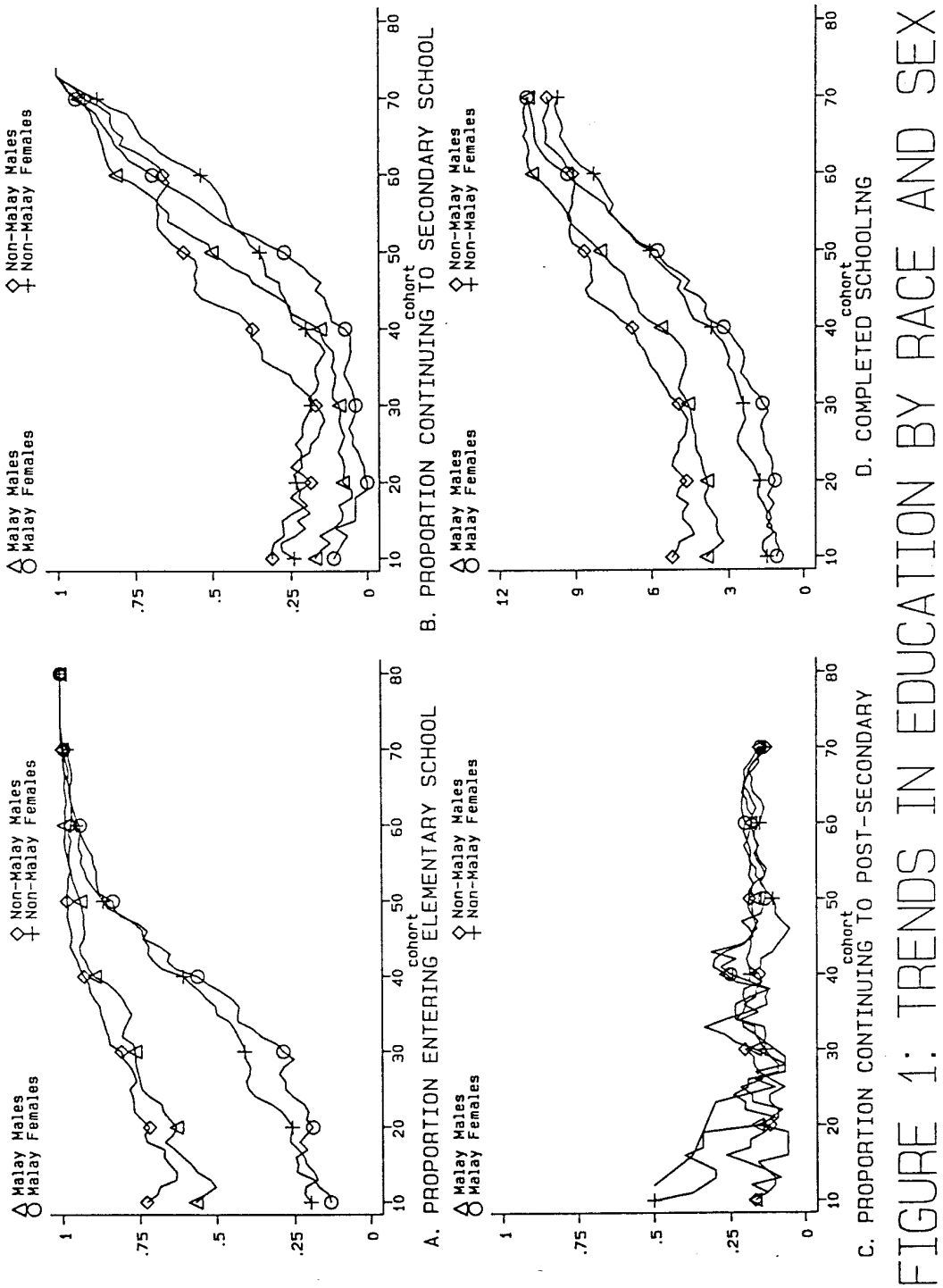

FIGURE 1: TRENDS IN EDUCATION BY RACE AND SEX

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