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DROPOUT AND ENROLLMENT TRENDS IN THE POST-WAR PERIOD: WHAT WENT WRONG IN THE 1970s?

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ABSTRACT

Over most of the 20th century successive generations of U.S. children had higher enrollment rates and rising levels of completed education. This trend reversed with the baby boom cohorts who attended school in the 1970s, and only resumed in the mid-1980s. Even today, the college entry rate of male high school seniors is not much higher than it was in 1968. In this paper, we use a variety of data sources to address the question "What went wrong in the 1970s?" We focus on both demand-side factors and on a particular supply-side variable – the relative size of the cohort currently in school. We find that tuition costs and local unemployment rates affect schooling decisions, although neither variable explains recent trends in enrollment or completed education. We also find that larger cohorts have lower schooling attainment, and that aggregate enrollment rates are correlated with changes in the earnings gains associated with a college degree. For women, our results suggest that the slowdown in education in the 1970s was a temporary response to large cohort sizes and low returns to education. For men, however, the decline in enrollment rates in the 1970s and slow recovery in the 1980s point to a permanent shift in the inter-cohort trend in educational attainment that will affect U.S. economic growth and trends in inequality for many decades to come.

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I - Introduction

Over most of the last century successive cohorts of children had rising enrollment rates and increasing educational attainment. This trend stopped abruptly with cohorts that entered high school in the late 1960s. Young men's high school completion rates drifted down over the 1970s while their college entrance rates plummeted. Young women's high school graduation and college entry rates were stagnant. As a consequence, men and women born in the 1960s had about the same high school graduation rates, *and lower four-year college graduation rates*, then men and women born a decade earlier. Even by the late 1990's college entry rates of young men were no higher than 30 years earlier. This lack of inter-generational progress stands in marked contrast to earlier trends, and poses a major puzzle: What went wrong in the 1970s?

Any slowdown in the rate of growth of educational attainment is a cause of obvious concern. Apart from the fact that better-educated workers earn more, and experience a range of other benefits, including lower unemployment, better health, and longer life expectancy (Haveman and Wolfe, 1984), a slowdown in the rate of human capital accumulation will lead ultimately to slower economic growth for the economy as a whole, and is likely to cause continuing upward pressure on the earnings differentials between more and less educated workers (Katz and Murphy, 1992).

In this paper we use a variety of data sources to document trends in school enrollment and completed schooling attainment and analyze the underlying sources of these trends. In particular, drawing on the human capital investment model (Becker, 1967; Mincer, 1974), we focus on the role of various demand-side factors affecting the decision of when to leave school. These include changes in the expected economic return to an additional year of education, the level of real interest rates, tuition costs, and cyclical labor market conditions. We also highlight the role of a specific supply-side variable – the relative size of the cohort currently in school – that may be particularly relevant for understanding education outcomes of the baby boom generation.

A major difficulty confronting any analysis of long-run trends in education outcomes is the absence of micro-level data sets that include information on family background factors, geographic location, and schooling outcomes for a broad range of cohorts. Conventional micro data sets such as the Current Population Survey and the Decennial Censuses lack any family background data. On the other hand, specialized education data sets such as High School and Beyond cover only a narrow range of cohorts. To address this problem we pursue a multi-level estimation strategy. We begin by using individual micro data from the General Social Survey to examine the contribution of changing family background factors to inter-cohort trends in high school and college graduation. Next, we turn to an analysis of average enrollment and completed schooling outcomes for individuals born in specific cohorts and states. Here, we focus on the effects of three local-level variables: state unemployment rates, tuition levels at state colleges and universities, and the relative size of the high school cohort in the state. Finally, we use time series models to analyze the role of purely aggregate explanatory variables, including the real interest rate and the rate of return to education for young workers.

Although family background factors are important determinants of individual schooling outcomes, we conclude that they cannot explain the slowdown in enrollment or educational attainment for post-1950 cohorts. Likewise, tuition costs and local unemployment rates do not move in the right direction to explain longer run trends in enrollment. Cohort size is a more promising explanation for the slowdown in education among post-1950 birth cohorts, though our preferred estimates imply only a modest aggregate effect associated with the baby boom's passage through the education system. Changes in the return to education for young workers are highly correlated with the enrollment rates of college-age youth, and this variable, coupled with cohort size and trend factors, can explain the changes in male and female college-age enrollment rates over the 1968-96 period fairly well. For women, our results imply that the slow growth in enrollment in the 1970s was largely a temporary phenomenon, driven by low returns to education and the size of the baby boom cohort. For men, however, the decline and slow rebound in enrollment seem to reflect a combination of adverse temporary factors (a large cohort and low returns to education) coupled with a virtual collapse in the long-run trend in educational attainment.

II - Trends in Dropout Behavior and Educational Attainment

This section provides a descriptive overview of basic trends in enrollment, dropout behavior, and completed education in the US over the past several decades. We begin by examining data on enrollment and dropout rates derived from the School Enrollment Supplements of the 1968 to 1996 Current Population Surveys (CPS). A key limitation of this analysis is the absence of CPS microdata prior to 1968. To provide a longer time series context, we turn to cohort-level data on high school and college completion rates. Patterns of enrollment and completed education among children in the National Longitudinal Survey of Youth (NLSY) confirm that there is a relatively tight link between teenage enrollment and completed education later in life. In light of this fact, we use information on completed education for adults in the 1960-1990 Decennial Censuses and recent Current Population Surveys to measure inter-cohort trends in educational attainment for cohorts born from 1920 to 1970. These longer-term trends provide a valuable historical context for evaluating changes in enrollment and completed education among more recent cohorts.

a. Time Series Patterns in Enrollment

Figures 1a and 1b graph enrollment rates of young men and women by age over the 1968-96 period. The underlying data are drawn from the October CPS, and pertain to school enrollment (full-time and part-time) as of mid-October. An examination of the figures suggests that enrollment rates of 16 year-old men and women have been quite stable over the 1968-96 period, while 17 year olds experienced a slight dip in enrollment in the late 1960s followed by modest rises in the late 1980s and 1990s.[1] More remarkable are the

1Published tabulations of the October CPS data, available for 1945-1967, show that enrollment rates of 14-17 year olds rose from just under 80 percent at the end of World War II to around 92 percent by the late 1960s, and have been relatively stable ever since. (1997 Digest of Education Statistics, Table 6).

patterns for college-age youth -- particularly men. The enrollment rates of 18-21 year old men declined from the late 1960s to the mid-1970s, stabilized over the late 1970s, and then rose in the 1980s and 1990s. Despite recent gains, the fraction of 18-21 year old men in school today is not much higher than it was in the late 1960s. Enrollment rates of 18-21 year old women held steady during the 1970s and then began rising. As a consequence, the fraction of 18-21 year old women in school in the late 1990s is much higher than in the late 1960s, and the enrollment rate of 19 year old women is now above the rate for comparable men.

One potentially important aspect of enrollment behavior among college-age youth (i.e., those age 19 and older) is the fraction enrolled in 2-year versus 4-year colleges (see, e.g., Rouse, 1994). Information on type of college attended by enrolled students has been collected in the CPS since 1976, and shows a slight rise in the relative share of 2-year colleges over the past two decades. Specifically, the fraction of 19-21 year-old men who were enrolled in 2-year versus 4-year colleges rose from 23.9 percent in 1976 to 25.7 percent in 1986 and to 26.5 percent in 1996. Among 19-21 year old enrolled women the fraction in 2-year colleges was 22.3 percent in 1976 and rose to 27.9 percent in 1986 before falling back slightly to 27.3 percent in 1996.[2] These figures point to a modest shift in the nature of college enrollment – especially for women – that should be kept in mind in interpreting overall enrollment trends. In particular, a rise in the fraction of enrollment at 2-year colleges implies that traditional college graduation rates (based on four years of college) will not rise as quickly as college-age enrollment.

Another factor that has some possible impact on the trends in enrollment in Figures 1a and 1b is the changing racial composition of the population. Over the past 30 years the fraction of nonwhites in the teenage population (ages 16-19) has risen from 13.6 percent in 1968 to 21.2 percent in 1996. To the extent that nonwhites have systematically lower or higher enrollment rates than whites, this change would be expected to cause some trend in average enrollment rates. As it turns out, however, the gap in enrollment

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2The gain in share for women from 1976 to 1996 is statistically significant (gain of 5.0 percentage points, standard error of 1.9 percent) while the gain for men is not (gain of 2.6 percentage points, standard error 2.0 percent).

rates between nonwhite and white teenagers varies: in 1968, nonwhites had 3.3 percent lower enrollment rates than comparable whites, while in 1976 nonwhites had 2.8 percent higher enrollment rates than whites. During the later 1980s and 1990s the gap was typically negative but small in absolute value. These changing patterns are illustrated in Figure 2, which graphs enrollment rates for 18 year olds by race and gender. Black enrollment rates were below those of whites in the late 1960s and early 1970s, then surged between 1973 and 1976 and remained above white rates until the early 1980s, when whites caught up. We are unsure of the reasons for the relative enrollment gains of blacks in the mid-1970s. One hypothesis is that the early wave of affirmative action programs in higher education led to a rise in black enrollment rates that reversed with the scaling-back of these programs in the early 1980s.[3]

We have also examined the implications of the rising fraction of Hispanic youth on trends in average enrollment rates. CPS data on Hispanic ethnicity are available from 1973 onward, and show a steady rise in the proportion of Hispanic teenagers from 5.2 in 1973 to 13.0 percent in 1996. On average Hispanics have lower enrollment rates than non-Hispanics – about 6 percentage points lower at age 16, and 10-12 percentage points lower at ages 17, 18, and 19. Thus, the rising fraction of Hispanic youth has contributed to a modest downward trend in average enrollment rates. Among 17-19 year olds, for example, the rise in the proportion of Hispanics has probably led to a 1 percentage point drop in average enrollment rates for all youth over the 1973-96 period.

The lower enrollment rate of Hispanic youth is attributable to several factors. Perhaps most importantly, many young Hispanics are immigrants from Mexico and Central America, and many others are "second generation" children of poorly educated immigrants. Data from the 1995 October CPS suggest that 30 percent of Hispanic teenagers are immigrants, and another 26 percent are native-born with an immigrant mother. The enrollment rate of Hispanic immigrant teenagers in 1995 was relatively low (57 percent on average, compared to 73 percent for Hispanic natives and 79 percent for non-Hispanics), and even lower

3See the discussion in Bowen and Bok (1998), pp. 7-10.

among the roughly one-half who have arrived in the U.S. within the last 5 years (47 percent). Interestingly, however, the enrollment rate among "second generation" Hispanic teenagers is higher than that for Hispanics teenagers whose mothers were born in the U.S. (76 percent versus 70 percent).[4]

A final factor that may complicate the interpretation of age-specific enrollment rates is a change in the grade distribution of enrolled students. Many students presumably stay in school until they reach a target grade (rather than a target age). Thus, a shift in the grade distribution of students can lead to a change in enrollment propensities at each age without necessarily signaling a change in the desired level of completed schooling. One important source of such shifts is a change in the fraction of students who have been held back a year (or who started school late). In fact, there is evidence of a modest decline in the average grade attended by a given age group over the past 30 years that may account for some rise in age-specific enrollment rates.[5]

An alternative to studying the enrollment rate for a given age group is to examine the rate at which students move to higher levels of the education system. Figures 3a and 3b show data from 1968 to 1996 for three such transition rates: the probability that a student who was enrolled in 11th grade last October is enrolled in 12th grade this October (i.e., the probability of finishing 11th grade and entering the 12th with no interruption); the probability that a student who was enrolled in 12th grade last October has obtained a high school diploma by this October (i.e., the probability of high school graduation, conditional on attending 12th grade last year); and the probability that a student who was enrolled in 12th grade last October is enrolled in

4Card, DiNardo, and Estes (2000) find that "second generation" individuals typically have relatively high education levels, controlling for parental education.

5A regression of current grade on race and gender dummies (interacted) and year dummies using data on enrolled students in the 1968-96 CPS files shows a fall of about 0.1 in the mean grade attended over the past 30 years. The drop is similar for students aged 17, 18, and 19. A look at the distribution of grades attended by a given group leads to the same conclusion. In 1968, for example, 20 percent of enrolled 17 year old men were in 11th grade, 63 percent were in 12th grade, and the remainder were in other grades. By 1996, the fraction in 11th grade had risen to 30 percent while the fraction in 12th grade had fallen to 58 percent.

college this October (i.e., the college entry rate for those who were high school seniors).[6]

As might be expected from the trends in enrollment rates for 16 and 17 year olds in Figures 1a and 1b, the retention rates from 11th to 12th grade for both men and women are very stable over the 1968-96 period, averaging about 95 percent. Rates of high school completion (conditional on having been enrolled in 11th grade) are also fairly stable at around 92-94 percent, although in the last few years the rates seem to have slipped. For both men and women the college entry rate (for those who were in 12th grade last year) follows a pattern similar to that of the enrollment rate of 18 year olds. This is not too surprising, since 18 year olds are typically either just finishing their last year of high school, or have recently graduated from high school. Given the stability of the transition rate from 11th to 12th grade, most of the variation in the enrollment rate of 18 year olds arises from changes in the college entry rate. Interestingly, the college matriculation rate of young men is no higher in the late 1990s than in 1968, while the rate for young women has risen about 18 percentage points over the past 30 years.

b. Inter-cohort Trends in Completed Education

Preliminary Issues

On the basis of the data in Figures 1-3 it is difficult to assess the significance of the decline in male enrollment during the 1970s, or the recent gains for women. Depending on how enrollment rates were moving prior to 1968, these changes may represent a sharp departure from historical patterns or a continuation of pre-existing trends. Unfortunately, pre-1968 CPS microdata are unavailable.[7] To provide

6The October CPS supplement asks individuals if they were enrolled last year, and when they obtained a high school diploma. We assume that all those enrolled in 12th grade were enrolled in 11th grade in the previous year.

7The decennial censuses also report school enrollment, although the question pertains to the census week (April 1st). Comparisons of enrollment in the 1970 Census and the 1969-70 October CPS suggest that the timing of the question significantly affects age-specific enrollment rates, since the Census-based estimates are quite different from the October CPS numbers. Published tabulations of CPS enrollment data are available for 1945-67. Data on the enrollment of 18-19 year old men and women shows a roughly constant trend from 1945 to 1968.

an historical context for the post-1968 trends in enrollment behavior, we decided to use the Decennial Censuses and Current Population Surveys to construct data on completed education by birth cohort. The key assumption underlying this exercise is that changes in youth enrollment rates will be reflected in differences in completed education rates for the same birth cohorts. Under this assumption a comparison of the completed education of men born in 1945 with those born in 1955 will allow us to infer the trend in male enrollment rates between 1963 and 1973. Of course, one might argue that completed education is the main outcome of the education process: thus, inter-cohort comparisons of educational attainment are interesting in their own right, as well as for any insight they provide on school enrollment behavior. As a check on the assumption that completed educational attainment is highly correlated with enrollment behavior during ages 16-24 we analyzed a sample of men and women in the National Longitudinal Sample of Youth (NLSY) who can be followed from their teenage years to their early 30s. Specifically, we selected individuals age 14-16 in the first (1979) NLSY interview who missed no more than two interviews between 1980 and 1990. We used retrospective enrollment data collected in each wave of the survey to construct a series of fall enrollment indicators.[8] Table 1 summarizes the enrollment histories of this sample, focused on the question of how often people who drop out of school as teenagers ever return to continue their schooling.[9] For example, the first row of the table pertains to the 20 percent of the NLSY sample who was out of school in the fall after their 16th birthday. Of these, 75 percent never enrolled again in the fall term over the next 10 years. (A very small number were enrolled in the spring, or for less than three months in some later fall). Among the one quarter who subsequently re-enrolled, 56.3 percent were only enrolled in one term. Thus, a majority of those who ever returned to school obtained <u>at most</u> one additional year of formal schooling. Looking down the rows of the table, the fraction of those who drop out and never return at different ages is

8After much experimentation we settled on a fairly tight definition of fall enrollment: we coded an individual as enrolled if he or she reported being enrolled in school for at least 3 months between August and December.

9These tabulations are unweighted, and over-represent the experiences of relatively disadvantaged youth.

fairly stable at around 75 percent (for all but those who first drop out in fall of their 20th year), and the relative fraction of re-enrollees who attend for only a year or less is also fairly stable. Although some dropouts eventually return to school, the majority do not, and only a very few get much additional schooling.

Nevertheless, the measured educational attainment of early dropouts is somewhat higher than their formal schooling would suggest because of the acquisition of high school equivalency degrees (i.e., GED's – General Equivalency Diplomas).[10] As shown in the fifth column of Table 1, about one third of those who were not in school in the fall after their 16th birthday obtained a GED over the next 10 years, and a significant fraction of later dropouts also obtain GED certificates. Evidence in Cameron and Heckman (1993, Figure 1) suggests that the incidence of GED certification rose rapidly in the 1960s and 1970s: thus, GED acquisition rates for dropouts in earlier cohorts may be only 10-20 percent as high as the rates for the NLSY sample. To the extent that a GED certificate is not equivalent to a regular high school diploma[11], and GED holders are coded as regular high school graduates, the rising incidence of GED certification poses a problem for inter-cohort comparisons of completed education. A full consideration of this problem is beyond the scope of our analysis here. It should be kept in mind, however, in interpreting trends in high school graduation rates of more recent cohorts.

Educational Attainment by Cohort

We use data from the 1960-1990 Decennial Censuses and the 1996-99 March CPS to estimate measures of completed education by year of birth for native men and women born from 1920-1965. We begin by assuming that the educational attainment of an individual (indexed by i) who was born in year c and

10A GED is obtained by writing a test -- see Cameron and Heckman (1993). Census Bureau coding procedures assume that a GED is equivalent to a regular high school diploma: thus the Decennial Censuses and the CPS do not separately identify GED holders from regular high school graduates. The NLSY uses a similar rule.

11Cameron and Heckman (1993) argue that GED recipients are much closer to high school dropouts than high school graduates, although Tyler et al (1998) find that the GED has some effect on wage outcomes.

observed at age j in year t (t=j+c) follows a simple model of the form:

$$E_{icj} = a_c + f(j) + d_t + e_{icj},$$

where E_{icj} is the measure of education (e.g., years of completed schooling), a_c represents a birth cohort effect, f(j) is a fixed age profile (normalized so that f(j)=0 at some standard age), d_t is a year effect associated with any specific features of the measurement system used in year t, and e_{icj} represents a combination of sampling error and any specification error. The age profile is included to capture the fact that educational attainments tend to rise with age.[12] Thus, unless all cohorts are observed at exactly the same age, it is necessary to adjust the data for differences in the age at observation.

We fit this equation to data on individuals who were between 24 and 65 years old (and born between 1920 and 1965) in the public use samples of the 1960-1990 Censuses and the pooled 1996-99 March CPS.[13] We included a quartic polynomial in age (normalized to equal zero at age 40), year dummies for observations from the 1990 Census and the 1996-99 CPS (to reflect differences in the education questions in these surveys relative to the earlier Censuses), and a full set of year-of-birth dummies. We used two key measures of educational attainment: an indicator for having completed high school, and an indicator for having a college degree. The cohort effects associated with these outcomes are plotted in Figures 4a and 4b.[14]

The inter-cohort trends in these two measures of completed education are quite consistent with the enrollment trends reported in Figures 1a and 1b. For example, the stability of the enrollment rates of 16 and 17 year-old men and women after 1968 suggests that high school graduation rates have been relatively stable

12For example, in 1970, the average years of education reported by native men who were born in 1940 is 12.26 years. In 1980, the average for the same cohort of men is 12.85 years. Comparable means for the 1940 cohort of women are 11.91 average years of schooling in 1970 and 12.37 in 1980.

13Our 1960 and 1970 samples include 1 percent of the population; our 1980 and 1990 samples include 5 percent of the population; and our pooled CPS sample includes (approximately) 0.14 percent of the population. Our models are weighted to reflect the varying sampling probabilities.

14We estimated the cohort effects relative to a reference group of people born in 1950. For purposes of the graphs we then estimated the average outcomes of the reference group in 1990 (when they were age 40) and added these to the relative cohort effects.

for cohorts born after 1950: this is confirmed by the patterns in Figure 4a. On the other hand, the decline in enrollment rates of men age 18-21 from 1968 to 1975 suggests than men born in 1957 (who were 18 in 1975) were less likely to complete a college degree than men born in 1950 (who were 18 in 1968). The data in Figure 4b confirm that there is indeed a sizable drop in the fraction of men with a college degree between the cohorts born in 1950 and 1957.

The most interesting feature of Figures 4a and 4b is the relative stagnation in educational attainment for post-1950 cohorts. This lack of progress is especially remarkable in light of the steady inter-cohort trend in high school and college graduation rates for earlier cohorts. Even among women there is almost no indication of a rise in college completion rates for cohorts born after 1945. At first glance the relative stability of the college graduation rate for women may seem inconsistent with the rising college entry rates for women shown in Figure 2b, and with the rising enrollment rates of 18-21 year old women shown in Figure 1b. We believe that the discrepancy is attributable to two factors. First, the fraction of women with some college (i.e., 13-15 years of completed education) shows some growth after the 1950 cohort.[15] Second, much of the rise in female enrollment rates observed in Figures 1b occurs after 1985, and presumably will be reflected in the completed education levels of cohorts born after 1965.

Another feature of the college graduation rates in Figure 4b is the divergence in trends between men and women for cohorts born from 1945 to 1950. Men in this cohort graduated at slightly higher rates than would be predicted based on earlier trends, while women's graduation rates followed the existing trend rather closely. The relative gain for men was quickly reversed with the 1950-55 cohort, as men's graduation rates fell and women's continued to rise.[16] One explanation for the divergence is draft avoidance behavior

15Relative to the 1950 birth cohort (49 percent of whom had some college by age 40), those born in 1960 have a 1.7 percentage point higher rate of completing some college, and those born in 1965 have a 4.5 percentage point higher rate of completing some college. Among men, however, rates of completing some college fell from 57 percent for the 1950 cohort to 50 percent for the 1960 cohort and 53 percent for the 1965 cohort.

16Notice that the relative decline in male college graduation rates from the 1945 to 1955 cohorts is consistent with the relative decline in enrollment rates of college-age men from 1968 to 1974 observed in Figure 1.

associated with the Vietnam war. Throughout most of the war, college deferments were available that allowed enrolled students to delay the final determination of their draft status and potentially avoid compulsory military service.[17] The relative rise in men's college graduation rates for the 1945-50 cohort – who were at high risk of induction but eligible for education deferments – is consistent with the view that draft avoidance behavior raised college enrollment and graduation rates.

To summarize, the available evidence suggests the following conclusions regarding trends in enrollment and completed education:

> 1. High school completion rates rose steadily for cohorts born from 1920 to 1950 (at a rate of about 12-14 percentage points per decade) but were relatively stable for 1950-65 cohorts at about 90 percent.
>
> 2. Enrollment rates of 16-17 year old men and women have risen slightly over the past 30 years, while the fraction of 11th graders who complete high school by the next fall has been roughly constant. Over the 1970-96 period, the rising fraction of Hispanics has lowered the average enrollment rate of 16-17 year olds by 0.5 to 1.0 percentage points.
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> 3. In the NLSY sample only a quarter of school leavers ever returns to formal schooling, and those that return typically do so for a year or less. However, many early dropouts (up to one-third of those who drop out before age 17) eventually obtain a GED. The presence of GED's leads to some over-estimation of the educational attainment of recent cohorts.
>
> 4. College graduation rates of men and women trended steadily upward for cohorts born from 1920 to 1945 (at a rate of 6-7 percentage points per decade). The male college graduation rate declined by about five percentage points for cohorts born from 1945 to 1955, and has risen slightly for later cohorts. The female college graduation rate was relatively stable for cohorts from 1950 to 1965.
>
> 5. The college entrance rate of male high school seniors fell from 1968 to 1980, then rose in the 1980s back to its earlier level. The rate has been relatively stable over the 1990s at about 62-65%. The college entry of female high school seniors was roughly constant from 1968-80, but has subsequently risen to a level as high or slightly higher than the male rate.
>
> 6. The fraction of 19-21 year old men in 2-year versus 4-year colleges has been relatively stable since 1976 at about 25 percent. The corresponding fraction for women has risen from 22 to 27 percent.

17The draft was operated by local draft boards that had considerable discretion in the use of deferrals. Deferrals were also available for certain occupations and for those with dependent family members.

III - A Theoretical Framework

In this section we present a simple version of the human capital investment model and summarize some of its key implications for the determination of individual schooling outcomes (see Rosen, 1977, and Willis 1986 for more in-depth surveys). Our main focus is on the insights that the model provides for explaining the time series and inter-cohort trends documented in the previous section.

Assume that individuals have an infinite planning horizon that begins at the minimum schooling leaving age (t=0), and that each individual chooses a level of schooling to maximize the discounted present value of lifetime earnings, net of education costs. Education is measured in years of school attended: an individual with S years of post-compulsory schooling has real earnings of y(S,t) in period t ($t \geq S \geq 0$). A student who is attending school at age t with S years of education can earn p(S,t) in part-time earnings, and must pay tuition costs of T(S). If people can only make a single once-for-all decision on when to leave school the appropriate objective function is

(1) $$V(S) = \int_0^S (p(t,t) - T(t)) \; e^{-rt} \, dt \; + \; \int_S^\infty y(S, t) \; e^{-rt} \, dt \; ,$$

where r is an individual-specific discount rate. The acquisition of an additional unit of schooling leads to a marginal cost of

(2a) $$MC(S) = y(S,S) - p(S,S) + T(S)$$

(measured in period S dollars), which includes two components: a net opportunity cost $y(S,S)-p(S,S)$ and an out-of-pocket cost T(S). On the other hand, a delay in school-leaving leads to a marginal benefit (measured in period S dollars) of

(2b) $$MB(S) = \int_S^\infty dy(S,t)/dS \; e^{-r(t-S)} \, dt = \int_0^\infty dy(S,S+\tau)/dS \; e^{-r\tau} \, d\tau$$

where $dy(S,t)/dS$ is the derivative of the earnings function with respect to schooling. If log earnings are additively separable in education and years of post-schooling experience (as assumed by Mincer, 1974), y(S,t) can be written as y(S,t) = g(S)h(t-S), in which case the marginal benefit of an added unit of schooling is

$$MB(S) = g'(S) \int_0^\infty h(\tau)\, e^{-r\tau}\, d\tau = g'(S)\, H(r) ,$$

where H(r) is a decreasing function of the interest rate. Assuming that the marginal cost of additional schooling rises faster than the marginal benefit, the criterion function V(S) is concave and the individual's schooling choice is determined by the condition MC(S) = MB(S).[18] This gives an optimal schooling choice that depends on the discount rate, tuition costs, the relative level of earnings for part-time enrolled students versus recent school leavers, and on the characteristics of the lifecycle earnings function.

As a basis case, assume that earnings are independent of age or experience, with

$$\log y(S,t) = a + bS - \tfrac{1}{2} k S^2 , \quad \text{for } k \geq 0 .$$

This specification assumes that the "marginal return to schooling" (i.e., the derivative of log earnings with respect to an additional year of schooling) is linear in years of completed schooling, with a strictly declining marginal return when $k > 0$. Under these assumptions, $MB(S) = 1/r \times (b - k S)\, y(S,S)$, and the optimal schooling choice satisfies the condition

(3) $$b - k S = r\,(1-\alpha(S)) + r\, T(S)/y(S,S) ,$$

where $\alpha(S) = p(S,S)/y(S,S)$ is the ratio of part-time student earnings to full-time earnings for a person with S years of completed education. If students earn nothing while in school and tuition is free then this equation leads to the familiar rule that an optimal level of schooling equates the marginal return on the last unit of schooling (the left hand side of (3)) with the discount rate (e.g., Willis, 1986). In such a "stripped down" model, $S = (b-r)/k$, and variation in schooling outcomes arises from two sources: differences in the return to education, and differences in discount rates. People with higher returns to education (i.e., a higher individual value of b) will leave school at a later age. Likewise, cohorts who anticipate relatively high returns to education (i.e., a higher average value of b) are likely to choose to extend their schooling relative to cohorts who perceive relatively low returns to education. On the other hand, people who have more

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18Note that $V'(S) = e^{-rS} (MB(S) - MC(S))$. For the case of an additively separable log earnings function, MB(S) is decreasing in S if g(S) is concave. If V(S) is concave, people who leave school will never want to return, so the assumption of a once-for-all dropout decision can be relaxed.

restrictive access to credit markets (i.e., a higher individual value of r), or who are in their teenage years during a period of high real interest rates (i.e., a higher average value of r for the cohort), are likely to choose lower levels of schooling.

More generally, the optimal schooling choice also depends on part-time/full-time relative earnings, and differences in tuition costs. Assuming that k>0, a rise in part-time earnings for students, holding constant the earnings of school leavers, will lead to higher levels of optimal schooling, while a rise in tuition will lead to a lower level of schooling.

The model presented so far builds in an assumption that people are indifferent between attending school and working. In this case, individuals with access to a perfect capital market can maximize lifetime utility by maximizing the discounted present value of earnings net of schooling costs. More generally, however, school attendance may require more or less effort than full time work. Let c(t) denote the level of consumption in period t (measured in real period t dollars), and assume that an individual receives utility u(c(t)) if he or she is out of school and working in period t (where u(·) is some increasing concave function), and utility $u(c(t)) - \phi(t)$ if he or she is attending school in period t. The function $\phi(t)$ measures the relative disutility of school versus work for the t^{th} year of schooling, and may be positive or negative. Finally, assume that individuals choose schooling and consumption to maximize

$$\int_0^S (u(c(t) - \phi(t))\ e^{-\rho t}\, dt \quad + \quad \int_S^\infty u(c(t))\, e^{-\rho t}\, dt \quad ,$$

where ρ is a subjective discount, subject to the constraint that the discounted present value of consumption (discounted at the interest rate r) is equal to the discounted present value of earnings minus discounted tuition costs. Under these assumptions it is readily shown that the marginal cost of the S^{th} year of schooling includes the terms in equation (2a) plus an added component:

$$1/\lambda\ e^{-(\rho - r)S}\ \phi(S) \quad ,$$

where λ is the marginal utility of wealth in the planning period.[19] This extra term is simply the dollar

19As in equation (2a), this is measured in period S dollars.

equivalent of the relative disutility of schooling in period S. As in the simpler case where $\phi(t)=0$, if the marginal costs of schooling are rising faster than the marginal benefits, an optimal schooling choice will equate the marginal cost of the last unit of schooling with the marginal benefit.[20]

Consideration of the relative disutility of schooling suggests an important route by which individual-specific factors -- particularly family background variables -- may influence schooling outcomes. Children of better-educated parents may be able to succeed more easily at higher levels of schooling, or may have stronger preferences for attending school versus working. Either way, such children will have a lower marginal cost of schooling and would be expected to acquire more schooling.

A longstanding idea in the education literature is that students tend to stay in school longer in a temporarily depressed labor market (see e.g., Gustman and Steinmeier, 1981 and Light, 1995). Returning to the simplified model represented by equations 1-3, assume that "normal" earnings y(S,t) are temporarily depressed by a fraction δ, and that this condition is expected to persist for Δ periods into the future, where $\delta\Delta$ is small.[21] During the recession, the optimal schooling choice for a student will (approximately) satisfy the equation

$$(3') \qquad b - k S = r (1-\alpha(S))(1-\delta) + r T(S)/y(S,S) ,$$

leading to a higher level of schooling than under normal conditions ($\delta=0$). Of course a temporary drop in earnings will only raise the optimal school-leaving age for students who would have otherwise dropped out during the recession.

At first glance, the case of a temporary labor market boom appears to be symmetric: a boom causes a rise in the opportunity cost of schooling that may lead some students to drop out earlier than they would in a stationary environment. The effect of a temporary boom is more complicated, however, because the

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20The derivative of lifetime utility with respect to schooling is λe^{-rS} { MB(S) − MC(S) }, where MB(S) is the same as in equation (2b) and MC(S) is the same as (2a), with the addition of the disutility of effort term.

21Specifically, earnings of an individual who is still in school at age t=S are $y(S,t)(1-\delta)$ for t in the interval from t=S to $t=S+\Delta$, and will return to the normal level y(S,t) for $t>S+\Delta$.

second order condition for an optimal schooling choice may fail if earnings of young workers are expected to fall in the near future. Under the assumption that individuals make a once-for-all school leaving decision, dropping out today closes off the option of future schooling. A simple comparison of the current marginal costs and benefits of schooling is only sufficient to characterize the optimal schooling choice when marginal costs are expected to rise faster than marginal benefits, in which case the option value of staying in school is zero whenever the current marginal cost exceeds the current marginal benefit. If marginal costs are expected to fall soon, it may be worthwhile to remain in school even if the current marginal cost is high. This line of reasoning suggests that the effect of a temporary boom will be to accelerate the school-leaving rates of those who were close to completing their optimal schooling, with little or no effect on those who would have otherwise completed substantially more education.

So far we have been assuming that individuals make a once-for-all school leaving decision. As noted in the discussion of Table 1, this seems like a valid assumption for most youth, although a significant minority of dropouts eventually returns to formal schooling. The preceding model can be extended to allow for the possibility of interrupted schooling. Analytically such a model is equivalent to a dynamic investment model in which "disinvestment" is impossible (see, e.g., Dixit and Pindyck, 1994). A general property of these models is that current school enrollment decisions will be more sensitive to variation in the current marginal cost of schooling than in models with a once-for-all schooling decision, because dropping out does not foreclose the option of returning to school when marginal costs are lower. In particular, a short-term boom is likely to lead more students to drop out of school when re-enrollment is feasible then when it is not. The extent of such "intertemporal substitution" in the timing of schooling is presumably limited by various institutional hurdles, and by the start-up costs associated with returning to school when the boom is over.[22]

22For example, most high schools will not allow a students to re-enroll after a certain age: thus, students who leave high school may have to return to "adult school".

It is an open question whether children who drop out of school and return later have chosen to interrupt their schooling to take advantage of short-term fluctuations in the opportunity cost of schooling, or whether their behavior reflects other factors outside the realm of the simple model we have presented. For example, in a more realistic model with credit constraints, liquidity-constrained youth may drop out of school for a few years and return when they have better access to credit or less pressing income needs. Another explanation for re-enrollment is that individuals have changing preferences – particularly with respect to the relative value of current versus future income. It is sometimes argued that youthful decision-makers tend to undervalue the future: in the schooling context this may lead some children to leave school "too early." If time preferences change between adolescence and adulthood, some people who dropped out early may ultimately decide to return to school. Finally, re-enrollment behavior may be attributable to mistakes or unexpected changes in the economy. For example, a teenager deciding on an optimal level of schooling in the late 1970s may have (mistakenly) assumed that the earnings differentials across education groups at that time would persist into the future. Within a few years the payoffs to education were much higher, and some dropouts may have returned to school to take advantage of the new information.

IV Decomposing Trends in Enrollment and Completed Schooling

a. Framework

The human capital investment model suggests that desired schooling attainment depends on a number of factors, including: (1) the expected return to an additional year of education; (2) the discount rate; (3) tuition costs; (4) the relative level of part-time earnings for students in school; (5) the disutility of school versus work; and (6) cyclical fluctuations that differentially affect earnings opportunities today versus expected earnings in the future. Some of these factors are common to all individuals in a given cohort (such as the general level of returns to education), some are shared by all members of a cohort who grew up in the same geographic area (such as the strength of the local labor market or the cost of attending a nearby public college), and some are purely idiosyncratic (such as tastes or aptitudes for schooling). In order to evaluate the potential contribution of these factors to the time series trends in enrollment and completed education, we posit a simple behavioral equation that relates the optimal schooling choice S_{ijc} for the i^{th} individual born in cohort c and raised in geographic region j to a vector of observable factors X_{ijc}, a set of cohort effects (α_c), a set of permanent location effects (γ_j), and a random component:

$$(4) \qquad S_{ijc} = X_{ijc}\beta + \alpha_c + \gamma_j + \epsilon_{ijc} .$$

This can be interpreted as a linear approximation to the solution for an optimal schooling choice as determined by an equation such as (3) or (3′).

Subdivide $X_{ijc} = \{ F_{ijc}, Z_{jc}, m_c \}$, where F_{ijc} includes individual-level variables such as parental education and other family background characteristics, Z_{jc} includes cohort and location-specific variables such as tuition rates and the local unemployment rate, and m_c includes variables that are common to everyone in a cohort, such as the interest rate or the expected return to education. Assuming that (4) is correct, the average level of schooling for individuals in cohort c from region j satisfies the equality

$$(5a) \qquad S_{jc} = F_{jc}\beta_F + Z_{jc}\beta_Z + m_c\beta_m + \alpha_c + \gamma_j ,$$

where F_{jc} is the mean level of the individual characteristics for the group. Similarly, the average level of schooling for all individuals in the cohort satisfies the equality

$$(5b) \qquad S_c = F_c\beta_F + Z_c\beta_Z + m_c\beta_m + \alpha_c,$$

where F_c and Z_c represent the mean values of the family background and regional variables for all those in cohort c. Equation (5b) implies that the growth in average educational attainment between any two cohorts (e.g. 1 and 2) can be decomposed as

$$(6) \qquad S_2 - S_1 = (F_2 - F_1)\beta_F + (Z_2 - Z_1)\beta_Z + (m_2 - m_1)\beta_m + (\alpha_2 - \alpha_1) .$$

If estimates of the coefficient vector (β_F , β_Z, β_m) and of the cohort-specific means (F_c , Z_c , m_c) are available, this equation can be used to compare the actual inter-cohort change in completed education with the change predicted by trends in individual and family background characteristics, local conditions, and the aggregate variables m_c. A similar approach can be used to decompose trends in enrollment or dropout rates. For example, assuming that desired schooling is determined by equation (4), the probability of being enrolled in the k^{th} year of education is $P(S_{ijc} > k)$, which can be approximated by a logistic regression model that includes X_{ijc} as well as region and cohort effects. Trends in average enrollment rates between cohorts can then be decomposed by simulating the change in average enrollment rates if there were no change in the mean characteristics, and comparing this with the actual change.

There are two key problems in estimating the components of a decomposition such as (6). The first is that the coefficients associated with the aggregate-level variables (the β_c's) are not identifiable in models such as equation (4) that include unrestricted cohort effects. The causal effects of aggregate variables (such as the interest rate or the average return to schooling) can only be identified through their time series correlations with cohort-average schooling outcomes. Given the short samples available, this is a relatively weak source of identification. A second and even more serious problem is the absence of micro-level data sets that include information on family background factors, geographic location, and schooling outcomes for a broad range of cohorts. CPS microdata files are only available starting in 1968, and lack any family background information for youth who are no longer living with their parents. Similarly, the decennial Censuses have no information on family background variables like parental education, and only very limited geographic information (place of residence and state of birth). On the other hand, the data sets that are conventionally used to study the micro-level determinants of education, such as the NLSY or High School and Beyond, cover a very narrow range of cohorts.

In light of these problems we pursue a mixed estimation strategy in trying to evaluate the determinants of the trends in enrollment and school attainment. We begin by using individual micro data from the General Social Survey (GSS) to examine the contribution of changing family background factors to inter-cohort trends in high school and college graduation. Next, we turn to an analysis based on average enrollment and completed schooling outcomes for individuals in specific cohorts and states. We focus on the effects of three local-level variables: state unemployment rates, tuition rates at state colleges and universities, and the relative size of the high school cohort in the state. Finally, we use aggregate time series data to examine the role of two key aggregate explanatory variables: the rate of return to education and the real interest rate at the time when a cohort is just finishing high school. Taken as a whole we believe that these three levels of analysis provide a fairly comprehensive assessment of the empirical content of the human capital investment model, and its ability to explain the trends in school enrollment and educational attainment documented in Section II.

b. The Contribution of Trends in Family Background

There is a substantial literature documenting the powerful effect of family background variables on individual education outcomes (see Card, 1999 and Solon, 1999 for overviews). Typically, parental education explains 20-25 percent of the cross-sectional variation in completed education, while factors like race, ethnicity, family size, and location provide additional explanatory power.[23] Despite the importance of family background in explaining individual education outcomes, changes in family background variables is not a strong candidate to explain the U-shaped pattern of male enrollment rates observed in Figure 1a, or the break in the inter-cohort trend in educational attainment observed for post-1950 cohorts in Figures 4a and 4b. The reason is that demographic, family structure, and family location variables tend to evolve smoothly over time. Moreover, average parental education is essentially a lagged value of average individual education. Given the rising education levels of cohorts born from 1920 to 1950, one would expect average parental education levels to have continued rising relatively smoothly until cohorts born in the mid-1970s. Thus, it is unlikely that a shift in the trend in parental education can explain the slow down in the rate of

23For example, in the NLSY sample used in Table 1, a regression of completed education (as of 1996) on race and hispanic ethnicity dummies, mother's and father's education, number of siblings, presence of a father in the home at age 14, region of residence at age 14, and an indicator for urban residence at age 14 has an R-squared coefficient of just over 25 percent. The parental education variables by themselves explain about 24 percent of the variance in completed education.

growth of educational attainment for cohorts born after 1950.

A full evaluation of the role of family background factors requires information on schooling outcomes and family background characteristics for a broad range of cohorts. One of the few available sources of such data is the General Social Survey, which has surveyed 1-2 thousand adults annually since 1972, and asked a range of family background questions. We used the pooled GSS sample for 1972-1996 to estimate a series of models for completed educational attainment among adults (age 24-70) who were born between 1900 and 1970. Given the relatively small number of individuals in this data set, we defined cohorts using 5-year birth intervals. These models are reported in Table 2, and include a cubic function of age at the time of the survey and unrestricted cohort effects, as well as the covariates shown in the table.[24] The effects of the family background variables in the GSS sample are generally similar to those obtained in other data sets. For example, comparing the models in columns 3 and 6 of Table 2 to a comparable model for the completed education of men and women in the NLSY, we find very similar effects of parental education in the two data sets: about 0.2 years of education per year of either parent's education.

To evaluate the effects of changing family background characteristics on inter-cohort trends in educational attainment, we began by fitting a second series of models (not shown in Table 2) that include only the cohort dummies and the polynomial in age at the time of the survey. The estimated cohort effects from these models are plotted in Figures 5 and 6 as the "unadjusted" fractions of men and women with a high school diploma or college degree by age 30. Assuming that the GSS sample of household heads is representative of the adult population, these unadjusted series should track the cohort effects plotted in Figures 4a and 4b, and indeed they show similar trends to the estimates based on Census and CPS data. In particular, the unadjusted GSS data show relatively stable high school graduation rates for men and women born after 1950, and relatively stable college graduation rates for cohorts of men born between 1950 and

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24The cubic in age is included to account for the age profile in educational attainment. The estimated coefficients in Table 2 are very similar to the results from models that exclude the cohort effects.

1965.[25] Unlike the Census/CPS data, however, the GSS data show continued gains in college graduation rates for women born from 1950 to 1965, relative to the 1945-49 cohort. We are unsure of the reason for the divergence. Given the much larger samples in the Census and CPS data sets, and the rather large sampling errors for the GSS-based estimates, we believe that the Census/CPS estimates should be treated as definitive.

In a second step, we used the models in Table 2 to calculate the predicted fractions of men and women in each cohort with a high school or college degree, under the assumption that the average values of the covariates were held constant for each cohort at the means for the 1945-49 birth cohort. These predicted attainment levels are plotted in Figures 5 and 6 as "adjusted" fractions of each cohort with a high school or college degree, and exhibit two interesting features. First, the adjusted graduation rates for the older (pre-1945) cohorts are uniformly above the unadjusted rates, but below the rates for the benchmark 1945-49 cohort. This configuration means that some fraction of the inter-cohort trend in educational attainment for pre-1945 cohorts is attributable to improving family background characteristics. Second, the adjusted graduation rates for the post-1950 cohorts are uniformly below the unadjusted rates, and below the graduation rates of the benchmark 1945-49 cohort in 3 out of 4 cases. The implication is that changing family background characteristics can "explain" larger increases in high school and college graduation rates than actually occurred among the post-1950 cohorts (for three of the four cases).

These findings are summarized in Table 3. Panel A shows the estimated fractions of high school and college graduates in three cohorts: an early cohort (born1920-24); the benchmark 1945-49 cohort, and a late cohort (born 1965-69). Panel B shows the actual inter-cohort changes in graduation rates, and the predicted changes attributable to changing family background characteristics. Comparing the 1920-24 and 1945-49 cohorts, the relative magnitudes of the predicted and actual changes suggest that improving family background characteristics can explain 20-60 percent of the rise in high school and college graduation rates.

25The college graduation rates of individuals born in the 1965-69 and 1970-74 cohorts are imprecisely estimated, since we only observe a relatively small number of these individuals as adults in later waves of the GSS.

Comparing the 1965-69 cohort to the 1945-49 cohort, however, the actual changes are smaller than the predicted changes in 3 out of 4 cases. Only the fraction of women with a college degree rose faster than predicted by changing family background characteristics, although as noted the GSS sample seems to overstate the rise in the college graduation rate of women among post-1950 cohorts. Based on the results in this table, we conclude that the rapid growth in educational attainment by men and women born prior to 1950 can be partially explained by improving family background characteristics, whereas the post-1950 slowdown is even more of a puzzle once changes in family background characteristics are taken into account.

c. The Effect of Local Variables

Having eliminated changes in family background as a possible explanation for the stagnation in enrollment and completed education among post-1950 cohorts, we turn to a second set of explanations, based on factors that potentially affect the education choices of individuals from the same cohort and location. The discussion in Section III suggests two potential variables of this type: the level of tuition at local colleges and universities, and cyclical conditions in the local labor market. Average tuition costs (adjusted for inflation) at state colleges and universities declined by about 18 percent over the 1970s, then began to rise fairly rapidly in the 1980s, with a 60 percent average increase between 1980 and 1992.[26] These national trends suggest that even if college entry rates are highly sensitive to tuition costs, tuition costs cannot explain the stagnation in enrollment rates over the 1970s, and the rebound in the 1980s. The overall effect of trends in labor market conditions is similarly unclear. Average unemployment rates trended up in the 1970s, peaked in the early 1980s, and trended down in the 1980s and 1990s (with an interruption during the 1990-92 recession). Other things equal, this pattern might have led to a rising incentive for enrollment in the 1970s and a declining incentive in the 1980s and 1990s. However, the discussion around equation (3´) focused on

26These comparisons are based on a population-weighted average of tuition levels at state colleges and universities. The tuition data were originally assembled by the University of Washington as part of a fee monitoring project, and were generously provided to us by Thomas Kane: see Kane, 1994 for a further description.

the effect of *transitory* labor market shocks, and it is unclear whether to interpret longer-run shifts in unemployment rates in this manner.

A third and more promising “local” variable that may have some impact on school enrollment and completed education is cohort size. While the standard human capital investment model focuses on factors that effect individual or per capita demand for education, a broader view of the education system suggests that shifts in population size may affect the per capita supply of education resources, and ultimately the amount of education acquired by members of smaller versus larger cohorts. In particular, students in larger cohorts may be "crowded out" of college if the capacity of the education system does not expand as rapidly as the student-age population, or if the system only partially adjusts to a temporary bulge in enrollment.[27]

At the national level, trends in enrollment are highly negatively correlated with the relative number of college age youth. This is illustrated in Figure 7, which plots relative cohort size (measured by the number of births 18 years earlier) and the college entry rates of male and female high school seniors over the period from 1968 to 1996. Cohort size increased rapidly from 1968 to 1975 (corresponding to the “baby boom” in births between 1950 and 1957) and then remained relatively stable until 1982 before falling precipitously in the “baby bust” era (i.e., for cohorts born after 1964).[28] These swings were matched by opposing movements in the college entry rate, suggesting that cohort size may provide at least a partial explanation for the aggregate trends in enrollment and education attainment noted in Section II.

To evaluate the effects of tuition, local labor market conditions, and cohort size on school enrollment rates we fit the models summarized in Table 4 to data on average enrollment rates by state and year for four

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27School quality also may be lower for larger cohorts, leading to a decline in the perceived benefit of school attendance and a decline in enrollment rates. We examined this hypothesis using state-level pupil teacher ratios for 1946-96, and found a significant positive effect of cohort size on the pupil-teacher ratio.

28The negative effect of cohort size on school enrollment suggested by the data in Figure 7 is the opposite of what one might have predicted by focusing on the role of labor market conditions in the school enrollment decision. For example, it is widely believed that larger cohorts depress the youth labor market (e.g. Welch, 1979; although see Shimer, 1998 for opposing evidence) leading to a fall in the opportunity cost of staying in school that could potentially lead to a rise in enrollment. The negative correlation between cohort size and college entry rates suggests that the baby boom had a bigger effect on the education system than on the labor market.

different age groups. These models take the form:

$$(7) \qquad P_{jt} = X_{jt}\beta + \gamma_j + \upsilon_t + e_{jt}$$

where P_{jt} is the average enrollment rate for a specific age group in state j in year t, X_{jt} includes state and year specific determinants of enrollment behavior, as well as the average characteristics of the school-age population in state s in year t, γ_j represents a set of fixed state effects, υ_t represents a set of fixed year effects, and e_{jt} represents a combination of sampling error and unobserved factors that also influence enrollment outcomes.[29] The dependent variables are estimated from the October CPS files for 1968-96. A limitation of these files is that only a subset of states are individually identified before 1977. Consequently, our sample contains observations for all the individually identified states in the years from 1968 to 1976, plus observations for all 50 states and the District of Columbia for 1977-96. The models are estimated by weighted least squares, using as a weight the number of people in the state/year/age-group cell for whom the dependent variable is measured.

The three key independent variables are the unemployment rate of prime age men (age 25-54) in the state in year t, the log of the relative number of people born in state s and in the age group relevant for the particular enrollment outcome, and the log of average tuition at public colleges and universities in the state. The unemployment rates are estimated by pooling data for each year from the March and October CPS files.[30] The tuition data pertain to rates for in-state students at the "lower level" state college and university systems in each state, and are only available for 1972-92.[31] The cohort size variables are constructed from population counts by state and year of birth from the public-use samples of the 1960, 1970, 1980, and 1990 Censuses.

29Note that the inclusion of year effects is equivalent to the inclusion of cohort effects.

30We pooled the two samples to reduce the effect of sampling errors. Based on the correlations of the state-level unemployment estimates from the two months, we estimate that the (weighted) reliability of the average of the unemployment rates is over 0.8.

31We follow Kane (1994) and Moretti (1999) in using tuition data at the "upper level" state universities for Alaska, Delaware, Hawaii, and Wyoming.

Specifically, we calculated the number of people born in each year in each state in each census, and then fit a model to the pooled set of population counts that expresses the log of the observed count for each state and year of birth in each Census as a function of the cohort's age (a cubic in age) and unrestricted cohort×year-of-birth effects. We use the latter as "smoothed" estimates of cohort size for a particular year of birth and state of birth.

The models in columns 1 and 2 of Table 4 pertain to the enrollment rate of 15 and 16 year olds. Virtually no one this age has completed high school: thus non-enrollment for this group is tantamount to having dropped out of high school. The coefficient estimates show a modest positive effect of higher unemployment on enrollment, with a stronger effect in the 1972-92 period for which tuition data are also available than over the entire sample. Cohort size has no effect on the enrollment behavior of these relatively young teenagers, while tuition levels have a small but significantly negative effect. Since college tuition rates presumably have no direct effect on the cost of attending school for 15 and 16 year olds, the finding of a significant tuition effect may seem anomalous. One interpretation of the estimate is that teenagers are more likely to stay in high school when college is expected to be less costly.

The dependent variable in columns 3-4 is the enrollment rate of 17 year olds. The vast majority of children this age is enrolled in 11th or 12th grade: thus shifts in enrollment of 17 year olds reflect shifts in high school completion rates. Overall enrollment is positively affected by unemployment, suggesting that students who are nearly finished high school are more likely to stay in school if unemployment is higher. The effect size is modest, however. A rise in the prime age male unemployment rate from 0.035 to 0.065 is predicted to raise enrollment of 17 year olds by about 1 percentage point. As for the 15-16 year olds, enrollment of 17 year olds is unaffected by state-specific cohort size, but is significantly negatively related to tuition levels at local public colleges.

Columns 5-8 present results for 18 year olds. About two-thirds of enrolled 18 year olds are in college, while most of the rest are high school seniors. Unlike the results for younger students, the estimated effects of unemployment on this age group are weak and variable in sign, with some indication of a negative effect on college enrollment rates. A possible explanation for this result is that college attendance rates are negatively affected by rises in the opportunity cost of school and positively affected by rises in parental income (perhaps because of borrowing constraints). A rise in unemployment causes both variables to fall, with a small net effect on college enrollment. Unlike the models for younger teenagers, the results for 18 year olds show a significant negative impact of cohort size on enrollment. The coefficient estimates imply that a 10 percent larger birth cohort in a state is associated with about a 1 percentage point lower enrollment rate among 18 year olds, holding constant national trends and permanent state effects. The estimated impacts of college tuition are negative and significant, but again relatively modest in size. For example, a 25 log point increase in tuition is estimated to lower enrollment rates of 18 year olds by about 1 percentage point.

Finally, in columns 9-12 we present results for 19-21 year olds, with separate results by gender. The unemployment effects for this older age group show an interesting pattern, with very small effects for young men but more negative effects for young women. It is possible that this difference arises because young men's earnings are more cyclically sensitive than young women's, whereas their parents' incomes are equally responsive to local unemployment fluctuations. In this case, poor labor market conditions mainly affect young women through their parent's incomes, while young men are affected both through an opportunity cost channel and a parental income channel, with offsetting effects. Cohort size has somewhat larger effects on 19-21 year olds than 18 year olds, with comparable magnitudes for men and women. Finally, higher tuition exerts a small negative effect on the enrollment rate of 19-21 year old men, but a substantially larger negative effect on women. We are uncertain of the reasons for the gender differential, although it may be driven in part by differences in choice of college program, and/or by differences in the resources of young women relative to young men.[32]

32As noted in Section II, women are slightly more likely to attend junior (2 or 3 year) colleges than men. Young women are also less likely to live with their parents (Card and Lemieux, 2000).

As noted in Section II, the October CPS data can be used to examine dropout or retention rates at specific grade levels as well as enrollment rates at a given age. Table 5 presents a series of models fit to state×year average probabilities of finishing 11^{th} grade and starting 12^{th} grade, finishing 12^{th} grade, and finishing 12^{th} grade and starting college.[33] The sample sizes available for calculating these grade-specific retention probabilities are quite small for some of the smaller states. Thus, the dependent variables in Table 5 are somewhat "noisier" than the ones in Table 4. On the whole, however, the results are quite consistent with the results in Table 4: higher unemployment leads to higher probabilities of attending and finishing the last year of high school; while larger cohort size and higher college tuition lead to a reduced probability of attending college.

Our final set of results, in Table 6, pertain to completed education by state of birth and year of birth. In this table, the dependent variable consists of observations on mean educational attainment for individual state×year-of-birth cells in the 1960, 1970, 1980, and 1990 Censuses. (Observations are only included for groups that are between the ages of 24 and 65 at the time of the Census). The models have the form:

$$S_{jc\tau} = X_{jc}\beta + h(Age_{c\tau}) + \alpha_c + \gamma_j + d_\tau + e_{jc\tau}, \quad (8)$$

where $S_{jc\tau}$ is the average years of education among individuals born in state j in cohort c and observed in Census year τ (or the fraction of the state-of-birth and cohort group with a certain level of education), X_{jc} represents a set of state and cohort-specific determinants of completed education, $h(Age_{c\tau})$ represents a polynomial function of the age of cohort c in Census year τ, α_c represents an unrestricted cohort effect, γ_j represents a state effect, d_τ is a dummy for the specific Census year (restricted to be the same for all years except 1990, when the Census introduced a new education question), and $e_{jc\tau}$ represents a combination of sampling errors and other unobserved factors that influence completed education outcomes. The key covariates of interest are cohort size, the unemployment rate experienced by the cohort×state group at age

33The probability of "finishing 11^{th} grade" is estimated by the fraction of people in the October CPS who are enrolled in 12^{th} grade, conditional on being enrolled in 11^{th} grade the previous year. The other retention rates are estimated similarly.

17, and the level of tuition for the cohort×state group at age 18.[34]

Not all individuals who were born in a given state actually lived there during their teenage years. Thus, relative to a specification in which each individual's education outcome is associated with the specific unemployment rate and tuition level that he or she actually faced, estimates from specification (8) are likely to be attenuated by a factor that varies with the probability that an individual who was born in state j actually lived there during high school and the transition to college.[35] Since 75-85 percent of teenagers live in their state of birth, we suspect that the attenuation factor is on the order of 10-25 percent.

For each of the education outcomes, estimates are presented for three samples: a "maximum possible" sample that includes all cohorts born from 1910 to 1964, a "post-1940" sample that only includes cohorts born from 1940 to 1964, and a sample for which tuition data are also available (individuals born after 1954). Results for men are presented in the upper panel of the table, results for women in the lower panel. As in Tables 4 and 5, a larger cohort is associated with lower schooling, whereas a higher unemployment rate at age 17 leads to higher schooling. Contrary to the findings in Tables 4 and 5, however, there is no evidence of a negative effect of tuition on educational attainment. This may be due to the limited range of cohorts for which we have both completed education and tuition data: the samples in columns 3,6,9, and 12 are limited to only 11 birth cohorts.

A comparison of the relative effect of unemployment at age 17 on enrollment rates and completed education suggests that rises in unemployment have roughly consistent effects on the two. Specifically, the estimates in columns 1-4 of Table 4 imply that the total number of years of enrollment between the ages of 15 and 17 is raised by about 0.005-0.007 per point increase in the prime age male unemployment rate.[36] By

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34We use the state average unemployment rate over the calendar year as our measure of unemployment.

35A similar argument is made by Card and Krueger (1992) in their analysis of the effect of school quality on returns to education.

36To calculate this effect, we add the coefficient for the probability of enrollment at age 17 plus 2 times the coefficient for the probability of enrollment at ages 15-16.

comparison, the estimates in Table 6 imply that a 1-point rise in the overall unemployment rate at age 17 leads to about a +.008 increase in completed education. Given the sampling errors involved and potential attenuation biases, we regard these effects as roughly comparable. Interestingly, the results in Tables 4 and 6 both indicate that most of this impact is concentrated on the probability of finishing high school.

The impacts of cohort size on enrollment and completed education are also comparable. The estimates in Table 4 imply that total years of enrollment between ages 18 and 21 falls by about 0.044 per 0.1 increase in log cohort size, while the estimates in Table 6 imply a 0.04 - 0.06 reduction in total years of completed education and a one-half percentage point reduction in the probability of completing a college degree.

Taken as a whole the results in Tables 4-6 point to two main findings that are relevant for understanding the long-run trends in enrollment and completed education presented in Section II. First, cohort size has a modest negative impact on college enrollment and college completion that works in the right direction to explain some of the post-1950 slowdown in the inter-cohort trend in schooling attainment. To understand the implications of the estimates, consider the comparison between the 1946 and 1956 birth cohorts. Relative to the 1946 cohort, the 1956 cohort was 27 percent larger. The coefficients in Table 4 suggest that this rise in cohort size contributed to a 3 percentage point fall in the enrollment rate of 19-21 year-olds between 1966 and 1976 (about one fifth of the decline that actually occurred for men), while the estimates in Table 6 suggest that size effects led to a 1.4 percentage point lower college graduation rate for the 1956 cohort relative to 1946 cohort (a modest change relative to the trend shifts evident in Figure 4b). Second, changes in cyclical conditions and tuition levels probably had little or no impact on longer run trends in enrollment or completed education. This is a reflection both of the very small coefficient estimates associated with these variables, and the fact that trends in unemployment and tuition move in the wrong direction to explain a slow down in enrollment rates in the 1970s relative to earlier trends, or a rebound in college enrollment growth in the 1980s.

d. The Effect of Aggregate Variables

In this section we evaluate a third set of explanations for long-run trends in enrollment and completed schooling, associated with changes in aggregate-level variables. Specifically, we examine the effects of changes in the average return to education and changes in interest rates. Recall that in a simple human capital investment model the marginal benefit of additional schooling is just the discounted present value of the incremental gain in earnings. Under the assumption that log earnings are additively separable in years of education and post-schooling experience (x), the marginal benefit has the form:

$$MB(S) = d\log y_{sx}(S,x)/dS \times y_{sx}(S,0) \times H(r)$$

where $y_{sx}(S,x)$ denotes earnings as a function of schooling and experience, and H(r) is a decreasing function of the interest rate, with H(r)=1/r in the simplified case of a flat experience profile.[37] Since a rise in MB(S) will lead to higher schooling, this expression implies that people will invest in additional education if they perceive that their marginal returns ($d\log y_{sx}(S,x)/dS$) are higher, or if they face a lower discount rate.

Freeman (1976) and subsequent authors (e.g. Topel, 1997) have argued that teenagers use information on the current wage gap between recent college and high school graduates to gauge the size of their own future returns to schooling. Following this idea, we used information on the weekly earnings of full-time full-year workers in the March CPS to estimate the college-high school wage gap for men and women with 3-7 years of post-schooling experience. We refer to this wage gap (divided by 4) as the "return to education" for young workers in a given year.

Despite the symmetric roles played by returns to education and interest rates in the human capital investment model, few previous studies have focused on the link between interest rates and schooling decisions. Part of the difficulty may be in finding a relevant real interest rate for students who are considering borrowing money to finance an additional year of schooling. Many existing student loan

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37Using the notation from Section III, assume y(S,t) = g(S)h(t-S) = g(S)h(x), with h(0)=1. The marginal benefit of schooling is $MB(S) = g'(S) \int_0^{\infty} h(\tau) e^{-r\tau} d\tau = g'(S) H(r) = \partial\log y_{sx}(S,x)/\partial S \times y_{sx}(S,0) \times H(r)$. If h(x)=1 then H(r)=1/r.

programs use an interest rate that is linked either to the three-month treasury bill rate or the prime rate. The federally-subsidized and unsubsidized Stafford loan programs, and the Parent Loan for Undergraduate Students (PLUS) program, both use an interest rate that is linked to the 3-month treasury bill rate, while many private bank loans are linked to the prime rate.[38] Since these two rates move together very closely, we decided to use the prime rate as a nominal interest rate. We then subtracted the annual percentage change in the consumer price index to obtain a real interest rate.[39]

Figure 8 plots the return to college for young men, the real interest rate, and the college entry rates of male and female high school seniors over the 1968-96 period. (The return to college for young women follows a fairly similar path to the return for men, and is omitted in the interests of clarity). The college entry rate of young men is strongly positively correlated with the return to college (correlation coefficient = 0.80), while the correlation is a little weaker for young women (correlation = 0.74). On the other hand, there is no obvious negative connection between college entry rates and real interest rates. Indeed, the steep rise in real interest rates between 1979 and 1982 coincided with a modest upturn in college entry rates.

Table 7 presents a series of simple regression models fit to annual data on the college entry rate (columns 1-4) and the average enrollment rate of 19-21 year olds (columns 5-8) for the period 1968-96. All the models include a linear trend, and are fit separately by gender with gender-specific returns to education, the real interest rate, and aggregate cohort size as the other independent variables. The results in columns 1 and 5 confirm that college entry and enrollment rates are strongly related to changes in the average returns to college for young workers, even after controlling for trends. The models in columns 2 and 6 add our

38The subsidized Stafford loans use an interest rate equal to the 3-month Treasury Bill rate, plus 2.3 points. The PLUS program uses the Treasury Bill rate plus 3.1 points. A search of financial web sites offering student loans suggests that many banks and similar institutions charge the prime rate plus a small premium.

39We used the CPI-U-X1 for 1967-83 and CPI-U for later years as a price index. Our real interest rate for year t is $r(t) = i(t) - 100*(P(t) - P(t-1))/P(t-1)$, where i(t) is the annual average prime rate and P(t) is the annual average CPI in year t. We experimented with several different inflation adjustments and found that the resulting real interest rate series all had roughly similar impacts on enrollment.

estimate of the real interest rate: this variable has a negative effect, but is statistically insignificant in 3 out of 4 cases. Although not shown in the Table, we also fit a set of models that included the difference between the return to college and the real interest rate as an explanatory variable. This specification is motivated by an elementary version of the human capital model that assumes linearly declining returns to education, a flat experience profile, and no tuition costs or earnings while in school (see equation (3) above). Under these assumptions the optimal schooling level for an individual is $S=(b-r)/k$, where b is the individual's marginal return to education at the minimum level of schooling, and r is a person-specific interest rate. This model predicts that average schooling outcomes for a cohort will depend on the difference between the average return to education anticipated by the cohort and the average real interest rate faced by the cohort during their teenage years. As suggested by the results in Table 7, however, this specification fits much worse than one that simply ignores interest rates, so we decided to ignore real interest rates in the remainder of our analysis.

We noted in the discussion of Figure 7 that the decline in college entry rates between the late 1960s and late 1970s coincided with a rapid increase in the size of the college age population. Moreover, the findings in Tables 4-6 confirm that larger cohorts at the state level are associated with lower college enrollment. The models in columns 3 and 7 of Table 7 include the log of aggregate cohort size as an additional explanatory variable for aggregate enrollment trends. The inclusion of cohort size substantially reduces the size and estimated significance of the return to college variables. In fact, in none of the four models in the table is the returns to college variable statistically significant once cohort size is included. A problem with the specifications, however, is that in 3 of the cases the estimated effect of log cohort size is substantially bigger (in magnitude) than the estimates obtained using state×year data with unrestricted year effects. Indeed, in specifications not reported in the table that include only cohort size and a trend, the coefficient of log cohort size is about −0.50 in the models for male college entry and enrollment and about −0.25 in the models for female college entry and enrollment. These are 2 to 4 times bigger than the coefficients obtained in Table 4 using state×year data.

The facts that the aggregate models yield estimates of the cohort size effect that are "too big", and that cohort size is actually a better predictor of enrollment trends than changes in the returns to education, are causes for concern. The root of the problem is that returns to college vary nationally: thus any inferences must be based on aggregate time series correlations over a relatively short sample period.[40] Unfortunately, given that March CPS data are only available on a consistent basis from 1968 onward, we are unable to extend our estimates of the returns to education for young workers backward in time. Thus, there is no way to use the data on completed educational attainment for earlier cohorts to build a longer sample of data on schooling decisions and returns to schooling observed at ages 18-21.

If one believes that estimates based on the variation in enrollment outcomes at the state level provide more reliable information on the causal effect of cohort size (as we do), then a valid approach is to impose the estimates from the disaggregated approach on the aggregate data. The results of this exercise are reported in columns 4 and 8 of Table 7. Drawing on the results in Table 4, we use an estimate of -0.12 as the effect of log cohort size on college entry and enrollment. The specifications for men yield estimates of the effect of the return to college that are slightly smaller than the estimates from models that ignore cohort size, but not too different. In the models for women, on the other hand, the estimated effect of changing returns to college is substantially attenuated.

An important feature of the models in Table 7 is the sharp discrepancy between the estimated trends for women versus men. For women, the estimated trend growth rates range from 6 to 7 percentage points per decade. This is fairly similar to the inter-cohort trend in college graduation rates for women born between 1920 and 1950 (6 percentage points per decade), and suggests that there was no permanent slowdown in the rate of growth of educational attainment for women. Rather, the relative stagnation of enrollment rates in the 1970s was attributable to the temporary decline in the return to college for young

40There is some variation in returns to college across regions. However, an initial look at the data suggested that most of this is permanent. Moreover, recent college graduates are highly mobile and it may be unwise to assume that college entry decisions are made only on the basis of local returns to college.

women, coupled with a cohort size effect. For men, on the other hand, the estimated trends are all negative, and in the range of −1 to −3 percentage points per decade. This range represents a substantial departure from the very strong inter-cohort trend in male college graduation rates among pre-1950 cohorts (7 percentage points per decade) and suggests that the dip in educational attainment among post-1950 cohorts is not simply a result of low returns to college in the 1970s, but rather a combination of temporary factors (low returns to college and large cohort size) and a permanent trend shift.

Table 8 summarizes the implications of the models in Table 7 for aggregate trends in college entry and enrollment over the 1968-96 period. The upper panel of Table 8 shows average college entry rates and college-age enrollment rates in 1968, 1978, 1988, and 1996 for men and women, along with contemporaneous values of the return to college and cohort size. The middle panel of the table shows the 10-year changes in the variables. Of particular interest are the 1968-78 and 1978-88 changes. Over the 1968-78 period, returns to college dropped, cohort size rose, male enrollment rates fell dramatically, and female enrollment rates were fairly stable. Over the 1978-88 period, returns to college rebounded, cohort size shrunk, men's enrollment rates recovered somewhat, and women's enrollment rates grew rapidly. The bottom panel of the table shows the predicted changes in the schooling variables, based on the observed shifts in returns to college and cohort size and the coefficient estimates in columns 4 and 8 of Table 7. The actual and predicted changes for men over the 1968-88 period track each other reasonably well. The correspondence is less obvious for women, although if one takes account of a steady upward trend in female enrollment rates, the predicted and actual changes are fairly close. In particular, factoring in a 6 percentage point per decade upward trend in female college enrollment rates, female enrollment rates were predicted to rise 2-3 percent between 1968 and 1978, and 8-9 percent between 1978 and 1988. These are fairly similar to the actual changes. Over the 1988-96 period the models do less well in predicting the continuing rise in male enrollment, but a better job in predicting changes for women.

The results in Tables 7 and 8 point to two key conclusions. First, for women, changes in returns to education, coupled with the effect of larger cohort sizes and a strong underlying upward trend, provide a relatively good model for enrollment trends for college age youth over the 1968-96 period. Morever, the estimated trend is comparable to the inter-cohort trend in college completion rates for women born before 1950. Second, although changes in returns to education and cohort size also do a reasonably good job of predicting enrollment tends of young men over the 1968-96 period, the underlying trend in college entry rates over this period is zero or even slightly negative. By contrast, among cohorts born from 1920 to 1950, college graduation rates rose by about 6 percentage points per decade. Thus, even after accounting for the effect of changes in returns to education and cohort size, the dramatic trend shift in the inter-cohort rate of growth of college graduation for men evident in Figure 4b is essentially unexplained.

V. Conclusions

This paper begins by documenting trends in enrollment rates over the past 30 years, and trends in completed education for cohorts of U.S. children born from 1920 to 1965. Although earlier cohorts of children had rising enrollment rates and rising educational attainment, this trend stopped with the cohorts born after 1950 who began entering college in the late 1960s. The enrollment rate of 18-24 year old men declined sharply in the 1970s while the rate for women stagnated, with the net effect that cohorts born from 1950 to 1965 experienced little or no net growth in educational attainment. Enrollment rates began to rise again in the mid-1980s and have trended upward since then, but even today the fraction of male high school seniors that enters college immediately after graduation is not much higher than it was in 1968.

We then proceed to examine potential explanations for the slowdown in enrollment and educational attainment in the 1970s. Motivated by a human capital investment framework, we consider three sets of explanatory variables: individual level variables such as family background and location; market-level variables such as local unemployment rates, state-level tuition costs, and local cohort size; and aggregate-level variables such as interest rates and the wage gap between recent college and high school graduates.

An analysis of microdata from the General Social Survey suggests that improving family background characteristics can explain some of the rising trend in educational attainment for cohorts born prior to 1950, but none of the post-1950 slowdown. Indeed, controlling for family background the stagnant growth in educational attainment among later cohorts is even more of a puzzle. Next, we moved to an analysis of education outcomes at the state level, focusing on the impacts of three key market-level variables: unemployment, tuition costs, and cohort size. We find that higher unemployment rates lead to a rise in high school completion rates, while larger cohorts (at the state level) lead to lower college enrollment and completion. Cohort size moves in the right direction to help explain the slow down in enrollment and completed education among post-1950 cohorts, but the size of the effect is small. In particular, our estimates from the state-level analysis imply that the size of the baby boom potentially accounts for about one-fifth of the national decline in enrollment rates over the 1970s.

Finally, in the third stage of our analysis we examine the role of two purely aggregate variables: real interest rates and the college-high school wage gap for young workers. A simple time series analysis suggests that college entry rates and college-age enrollment rates are positively correlated with the return to college for young workers. A caveat to this conclusion is that enrollment rates are even more highly correlated with aggregate cohort size, and the latter dominates the former in a multi-variate model. Nevertheless, if we impose the cohort size effects estimated from our analysis of state-level enrollment, we find that models that include an underlying trend, cohort effects, and changes in the returns to education can explain the patterns of college entry and college-age enrollment observed over the 1968-96 period reasonably well. For women, the implied trends over the 1968-96 period are comparable to the inter-cohort trend in college graduation estimated for pre-1950 cohorts. For men, however, the implied trend over the 1968-96 period is zero or slightly negative -- much below the strong positive trend observed among pre-1950 cohorts.

In terms of “What happened” to college-age enrollment rates and educational attainment in the 1970s, the available evidence suggests different explanations for women and men. For women, the slowdown in enrollment growth rates in the 1970s appears to have been a temporary phenomenon, driven by low returns to education and the size of the baby boom cohort. For men, however, the slowdown seems to reflect a combination of adverse transitory shocks (a large cohort and low returns to education) and a discrete downward trend shift. Unless the underlying trend can be restored, our findings point to a rather pessimistic view about future rises in educational attainment, at least for young men. In addition, the relatively slow growth in educational attainment for cohorts born in the 1950s and 1960s may well have an "echo effect" on their children, slowing down the rate of growth of human capital in the U.S. economy for decades into the future.

References

Becker, Gary S. (1967). *Human Capital and the Personal Distribution of Income*. Ann Arbor, Michigan: University of Michigan Press.

Bowen, William G. and Derek Bok (1998). *The Shape of the River*. Princeton, NJ: Princeton University Presss, 1998.

Cameron, Stephen V. and James J. Heckman (1993). "The Non-equivalence of High School Equivalents." *Journal of Labor Economics* 11 (January), pp. 1-47.

Card, David (1999), "The Causal Effect of Education on Earnings." In Orley Ashenfelter and David Card, editors, *Handbook of Labor Economics* Volume 3. Amsterdam: Elsevier Science.

Card, David, John DiNardo, and Eugena Estes (2000). "The More Things Change: Immigrants and the Children of Immigrants in the 1940s, the 1970s, and the 1990s." In George J. Borjas, editor, *Issues in the Economics of Immigration*. Chicago: University of Chicago Press.

Card, David and Alan B. Krueger (1992). "Does School Quality Matter? Returns to Education and the Characteristics of Public Schools in the United States." *Journal of Political Economy*, 100 (February), pp. 1-41.

Card, David and Thomas Lemieux (1999), "Can Falling Supply Explain the Rising Return to College for Younger Men? A Cohort-Based Analysis." Center for Labor Economics UC Berkeley Working Paper

No. 13, February, revised.

Card, David and Thomas Lemieux (2000). "Adapting to Circumstances: The Evolution of Work, School, and Living Arrangements Among North American Youth." In David Blanchflower and Richard Freeman, editors, *Youth Employment and Joblessness in Advanced Countries*. Chicago: University of Chicago Press.

Dixit Avinash K. and Robert S. Pindyck (1994). *Investment Under Uncertainty*. Princeton NJ: Princeton University Press.

Freeman, Richard B. (1976), *The Overeducated American*, San Diego: Academic Press.

Gustman, Alan and Thomas Steinmeier (1981), "The Impact of Wages and Unemployment on Youth Enrollment and Labor Supply, *Review of Economics and Statistics* 63, pp. 553-560.

Haveman, Robert H. and Barbara L. Wolfe (1984), " Schooling and Economic Well-Being: The Role of Nonmarket Factors", *Journal of Human Resources* 19, pp. 377-407.

Kane, Thomas (1994), "College Entry by Blacks Since 1970: The Role of College Costs, Family Background, and the Returns to Education", *Journal of Political Economy*, 102, pp. 878-911.

Katz. Lawrence F. and Kevin M. Murphy (1992), "Changes in Relative Wages, 1963-1987: Supply and Demand Factors," *Quarterly Journal of Economics* 107, pp. 35-78.

Light, Audrey (1995), “Hazard Model Estimates of the Decision to Re-enroll in School”, *Labour Economics* 2, pp. 381-406.

Mincer, Jacob (1974), *Schooling, Experience and Earnings* (Columbia University Press, New York).

Moretti, Enrico (1999), “Estimating the Social Return to Education: Evidence from Repeated Cross Sectional and Longitudinal Data”, Center for Labor Economics UC Berkeley Working Paper No. 22, October.

Shimer, Robert (1999). “The Impact of Young Workers on the Aggregate Labor Market”, National Bureau of Economic Research Working Paper No. 7306, August.

Topel, Robert H. (1997). “Factor Proportions and Relative Wages: The Supply Side Determinants of Wage Inequality,” *Journal of Economic Perspectives* 11, pp. 55-74.

Rosen, Sherwin (1977). “Human Capital: A Survey of Empirical Research.” In Ronald Ehrenberg, editor, *Research in Labor Economics* (Vol. 1). Greenwich CT: JAI Press.

Rouse, Cecila E. (1994), “What to Do After High School? The Two-year vs. Four-year College Enrollment Decision,” in Ronald Ehrenberg, editor, *Contemporary Policy Issues in Education*, Ithaca, NY: ILR Press.

Solon, Gary (1999), “Intergenerational Mobility in the Labor Market,” in Orley Ashenfelter and David Card, editors, *Handbook of Labor Economics*, (North Holland, Amsterdam and New York), forthcoming.

United States Department of Education (1997), *Digest of Education Statistics*, Washington DC: USGPO.

Welch, Finis (1979). "Effects of Cohort Size on Earnings: The Baby Boom Babies' Financial Bust," *Journal of Political Economy* 87 part 2 (October), pp. S65-S97.

Willis, Robert J. (1986), "Wage Determinants: A Survey and Reinterpretation of Human Capital Earnings Functions", in Orley Ashenfelter and Richard Layard, editors, *Handbook of Labor Economics*, (North Holland, Amsterdam and New York).

Table 1: Fall Enrollment Histories for NLSY Sample Members Age 14-16 in 1979

	Percent Who First Drop out:	Percent of Dropouts Who: Never Return	Return	Percent of Those Who Return for 1 Term Only	Percent Who Get GED	Years of Education In 1996
Fall After Age 16 or Earlier	20.0	75.5	24.5	56.3	34.0	11.0
Fall After Age 17	27.9	75.0	25.0	46.2	13.1	12.4
Fall After Age 18	22.9	74.0	26.0	45.3	7.6	12.6
Fall After Age 19	9.0	74.3	25.7	34.5	8.6	13.1
Fall After Age 20	4.2	55.1	44.9	37.1	3.9	14.6
Fall After Age 21	6.0	72.1	27.9	54.0	–	15.8
Fall After Age 22	5.0	72.7	27.3	51.0	-	16.5
Fall After Age 23	2.6	83.5	16.5	68.8	–	16.6
Fall After Age 24	1.1	90.7	9.3	-	-	16.9
Fall After Age 25	0.7	100.0	-	-	-	17.8
Still Enrolled in Fall After Age 26	0.6	-	-	-	-	19.2

Note: Sample contains 3745 men and women in the NLSY who were 14-16 in 1979, and missed no more than 2 subsequent interviews. Individuals are classified as enrolled in the fall if they were enrolled 3 or more months from August to December. Tabulations are unweighted. Individuals are only followed until age 26: thus re-enrollment rates do not account for any schooling after age 26. Measured years of education in 1996 counts GED as high school.

Table 2. Estimated Models for Probability of Obtaining High School Diploma and College Degree, and for Years of Completed Education: General Social Survey Data

	Men			Women		
	High School (1)	College (2)	Years School (3)	High School (4)	College (5)	Years School (6)
Mother's Education	0.013	0.019	0.174	0.021	0.028	0.200
	(0.001)	(0.002)	(0.010)	(0.001)	(0.002)	(0.008)
Father's Education	0.014	0.032	0.199	0.017	0.025	0.172
	(0.001)	(0.002)	(0.010)	(0.001)	(0.001)	(0.007)
Single Mother	-0.069	-0.067	-0.470	-0.091	-0.074	-0.565
(at age 16)	(0.009)	(0.018)	(0.086)	(0.010)	(0.013)	(0.061)
Number Siblings	-0.005	-0.011	-0.046	-0.004	-0.012	-0.039
	(0.001)	(0.002)	(0.006)	(0.001)	(0.002)	(0.004)
Black	-0.028	-0.129	-0.629	0.000	-0.007	0.070
	(0.009)	(0.022)	(0.088)	(0.010)	(0.014)	(0.062)
Live in South	-0.039	-0.018	-0.394	-0.049	0.016	-0.189
(at age 16)	(0.009)	(0.016)	(0.080)	(0.010)	(0.012)	(0.061)
Live on Farm	-0.056	-0.160	-1.209	-0.035	0.004	-0.423
(at age 16)	(0.009)	(0.018)	(0.080)	(0.010)	(0.014)	(0.063)
Live in Small Town	-0.016	-0.072	-0.484	0.001	-0.019	-0.192
(at age 16)	(0.007)	(0.011)	(0.059)	(0.008)	(0.008)	(0.044)
No. Observations	10,687	10,687	10,687	13,344	13,344	13,344

Notes: Standard errors in parentheses. Entries in columns 1,2,4, and 5 are normalized logistic regression coefficients (multiplied by p(1-p) where p is the average probability of the education outcome for individuals born in 1945-49). Entries in columns 3 and 6 are OLS regression coefficients. Models are estimated on sample of adults age 24-70 in pooled 1972-1996 General Social Survey. Models include a cubic in age at time of survey, unrestricted cohort dummies (for 5-year birth cohorts), dummies for living in the Northeast and Midwest at age 16, and a dummy for having imputed father’s education (see text for imputation method). Sample includes only people who report their own education and their mother’s education.

Table 3. Decomposition of Inter-cohort Trends in Educational Attainment

	Men		Women	
	High School Diploma	College Degree	High School Diploma	College Degree
A. Estimated Percentage with Education Level By Age 30:				
1920-24 Cohort	62.1	16.9	53.5	5.3
1945-49 Cohort	88.0	32.4	83.9	20.9
1965-69 Cohort	92.1	34.8	89.3	33.5
B. Inter-cohort Changes:				
1920-24 to 1945-49 Cohort				
Actual Change	25.9	15.5	30.5	15.5
Change Explained By Changes in Family Background	12.8	10.5	11.1	3.5
1945-49 to 1965-69 Cohort				
Actual Change	4.0	2.3	5.4	12.6
Change Explained By Changes in Family Background	4.5	8.3	6.1	10.1

Notes: Based on logit models in Table 2. Family background variables used to explain changes in educational attainment include mother's and father's education, single mother at age 16, number of siblings, race, and measures of family location at age 16 (region of residence, farm residence, small town residence).

Table 4: Effects of Unemployment, Cohort Size, and College Tuition Rates on Enrollment Probabilities: Pooled State/Year Data for 1968-96

	Both Sexes Ages 15-16		Both Sexes Age 17		Both Sexes Age 18				Men Age 19-21		Women Age 19-21	
	Frac. Enrolled		Fraction Enrolled		Frac. Enrolled		Frac. in College		Frac. in College		Frac. in College	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Mean of Dependent Variable	0.964	0.963	0.873	0.870	0.581	0.569	0.380	0.376	0.378	0.362	0.350	0.344
Coefficients:												
Unemployment Rate	0.090	0.141	0.324	0.397	-0.138	0.106	-0.225	-0.085	-0.053	0.016	-0.224	-0.109
	(0.048)	(0.053)	(0.117)	(0.135)	(0.180)	(0.203)	(0.185)	(0.214)	(0.152)	(0.171)	(0.153)	(0.170)
Log Cohort Size	-0.005	0.010	-0.006	0.041	-0.101	-0.104	-0.086	-0.079	-0.111	-0.122	-0.121	-0.125
	(0.006)	(0.010)	(0.016)	(0.025)	(0.025)	(0.039)	(0.026)	(0.041)	(0.023)	(0.036)	(0.022)	(0.035)
Log Tuition	--	-0.014	--	-0.025	--	-0.036	--	-0.036	--	-0.011	--	-0.038
		(0.005)		(0.013)		(0.019)		(0.020)		(0.015)		(0.015)
R-squared	0.335	0.339	0.460	0.442	0.545	0.523	0.386	0.384	0.578	0.544	0.653	0.605
Observations	1167	866	1167	866	1167	866	1167	866	1167	866	1167	866

Notes: Standard errors in parentheses. All models include unrestricted state and year effects, as well as controls for the fraction of nonwhites, the fraction of females and (in columns 9-12) the average age of the group. Models are fit by weighted OLS, using the number of observations in the state-year cell as a weight. Unemployment rate is the average unemployment rate of men age 25-54 in the state in March and October of the calendar year. Cohort size is estimated number of people born in the state in the indicated age group, based on data from the 1960, 1970, 1980, and 1990 Censuses (see text). Tuition is the average amount of tuition and fees for state colleges and universities (see text). Sample includes individually identified states in the Current Population Survey from 1968 to 1996 (19 states in 1968-72 (including the District of Columbia), 13 states in 1973-76, and 51 states in 1977-96). Tuition data are only available for 1972-92 for 50 states (excluding District of Columbia).

Table 5: Effects of Unemployment, Cohort Size, and College Tuition Rates on Retention Probabilities: Pooled State/Year Data for 1968-96

	Finish 11th and Start 12th Grade		Finish 12th Grade		Finish 12th Grade and Start College	
	(1)	(2)	(3)	(4)	(5)	(6)
Mean of Dependent Variable	0.949	0.949	0.929	0.930	0.549	0.535
Coefficients						
Unemployment Rate	0.054 (0.079)	0.137 (0.090)	0.055 (0.106)	0.178 (0.119)	-0.074 (0.211)	0.167 (0.242)
Log Cohort Size	0.002 (0.011)	0.027 (0.012)	-0.021 (0.015)	0.015 (0.023)	-0.099 (0.029)	-0.034 (0.047)
Log Tuition	--	0.008 (0.008)	--	0.006 (0.011)	--	-0.036 (0.023)
R-squared	0.249	0.269	0.211	0.208	0.498	0.481
Observations	1115	816	1116	816	1116	816

Notes: See notes to Table 3. All models include unrestricted state and year effects and controls for the fraction of nonwhites and females and the average age of the risk group. In columns 1 and 2, retentions are defined over the set of people who were enrolled in 11th grade in the previous October. In columns 3-6, retentions are defined over the set of people who were enrolled in 12th grade in the previous October.

Table 6: Effects of Unemployment, Cohort Size, and College Tuition Rates on Completed Educational Attainment: Pooled Data by State of Birth and Year of Birth

	Years of Education			High School Graduate			Complete Some College			College Graduate		
	All Cohorts (1)	1940-1964 (2)	1954-1964 (3)	All Cohorts (4)	1940-1964 (5)	1954-1964 (6)	All Cohorts (7)	1940-1964 (8)	1954-1964 (9)	All Cohorts (10)	1940-1964 (11)	1954-1964 (12)
A. Men												
Log Cohort Size	-0.644 (0.026)	-0.899 (0.039)	-0.506 (0.071)	-0.100 (0.003)	-0.098 (0.005)	-0.062 (0.010)	-0.025 (0.002)	-0.097 (0.005)	-0.088 (0.016)	-0.037 (0.002)	-0.080 (0.005)	-0.044 (0.011)
Unemployment Rate Age 17	--	--	0.847 (0.322)	--	--	0.167 (0.044)	--	--	0.133 (0.070)	--	--	-0.010 (0.051)
Log Tuition Age 18	--	--	0.119 (0.035)	--	--	0.010 (0.005)	--	--	0.015 (0.008)	--	--	0.015 (0.006)
R-squared	0.938	0.938	0.970	0.948	0.934	0.968	0.955	0.958	0.963	0.901	0.926	0.951
B. Women												
Log Cohort Size	-0.508 (0.022)	-0.592 (0.029)	-0.363 (0.061)	-0.098 (0.003)	-0.089 (0.005)	-0.041 (0.009)	-0.016 (0.002)	-0.070 (0.015)	-0.085 (0.014)	-0.032 (0.002)	-0.057 (0.004)	-0.027 (0.011)
Unemployment Rate Age 17	--	--	0.842 (0.273)	--	--	0.176 (0.043)	--	--	0.200 (0.065)	--	--	-0.034 (0.048)
Log Tuition Age 18	--	--	0.027 (0.030)	--	--	0.006 (0.005)	--	--	0.001 (0.007)	--	--	0.008 (0.005)
R-squared	0.937	0.951	0.972	0.931	0.928	0.960	0.954	0.967	0.970	0.890	0.908	0.948

Notes: Standard errors in parentheses. Dependent variable is average educational attainment for men, by state of birth and year of birth, as measured in the 1960, 1970, 1980, and 1990 Censuses. State-of-birth/year-of-birth cells are only included for groups aged 24-65 at the time of the census. All models include unrestricted state and year effects, as well as a cubic function of the age at which education is observed, and a dummy for observations from the 1990 Census. Models are fit by weighted OLS, using the average size of the state birth cohorts from 1930 to 1960 as a weight. Unemployment rate is the average state unemployment rate in the calendar year the cohort was age 17. Cohort size is estimated number of people born in the state in the indicated age group, based on data from the 1960, 1970, 1980, and 1990 Censuses (see text). Tuition is the average amount of tuition and fees for state colleges and universities for the state of birth in the year the cohort was age 18 (see text).

Table 7: Estimated Time Series Models for College Entry Rate and Average Enrollment Rate of 19-21 Year Olds, 1968-96

	College Entry Rate of HS Seniors				Average Enrollment of 19-21 Year Olds			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<u>A. Men</u>								
Return to College	1.73	1.73	0.83	1.37	1.83	1.83	0.72	1.46
(% per year)	(0.28)	(0.29)	(0.48)	(0.27)	(0.28)	(0.27)	(0.44)	(0.22)
Real Interest Rate	--	-0.06	--	--	--	-0.33	--	--
(Prime-Inflation)		(0.25)				(0.24)		
Log Cohort Size	--	--	-0.29	-0.12	--	--	-0.36	-0.12
			(0.13)	(--)			(0.12)	(--)
Trend (x100)	-0.14	-0.13	-0.21	-0.17	-0.25	-0.21	-0.35	-0.29
	(0.09)	(0.10)	(0.09)	(0.09)	(0.09)	(0.09)	(0.08)	(0.08)
R-squared	0.68	0.68	0.73	0.56	0.66	0.69	0.75	0.56
<u>B. Women</u>								
Return to College	0.83	0.79	-0.11	0.45	0.56	0.48	0.29	0.17
(% per year)	(0.29)	(0.29)	(0.49)	(0.27)	(0.18)	(0.17)	(0.33)	(0.18)
Real Interest Rate	--	-0.19	--	--	--	-0.35	--	--
(Prime-Inflation)		(0.25)				(0.14)		
Log Cohort Size	--	--	-0.29	-0.12	--	--	-0.08	-0.12
			(0.13)	(--)			(0.08)	(--)
Trend (x100)	0.65	0.68	0.54	0.60	0.75	0.81	0.72	0.70
	(0.08)	(0.09)	(0.09)	(0.07)	(0.05)	(0.05)	(0.06)	(0.05)
R-squared	0.87	0.88	0.90	0.85	0.95	0.96	0.95	0.94

Notes: Standard errors in parentheses. Models are estimated on 29 annual observations for national average data. Return to college is estimated difference in mean log wages for full-time full year workers with 16 and 12 years of education, divided by 4. Returns are estimated separately for men and women using March CPS data. Real interest rate is difference between the prime rate and the percentage increase in the annual average CPI between the previous and current calendar year. Cohort size is number of births 18 years previously. In columns 4 and 8, the coefficient of log cohort size is constrained to equal -0.12. See text.

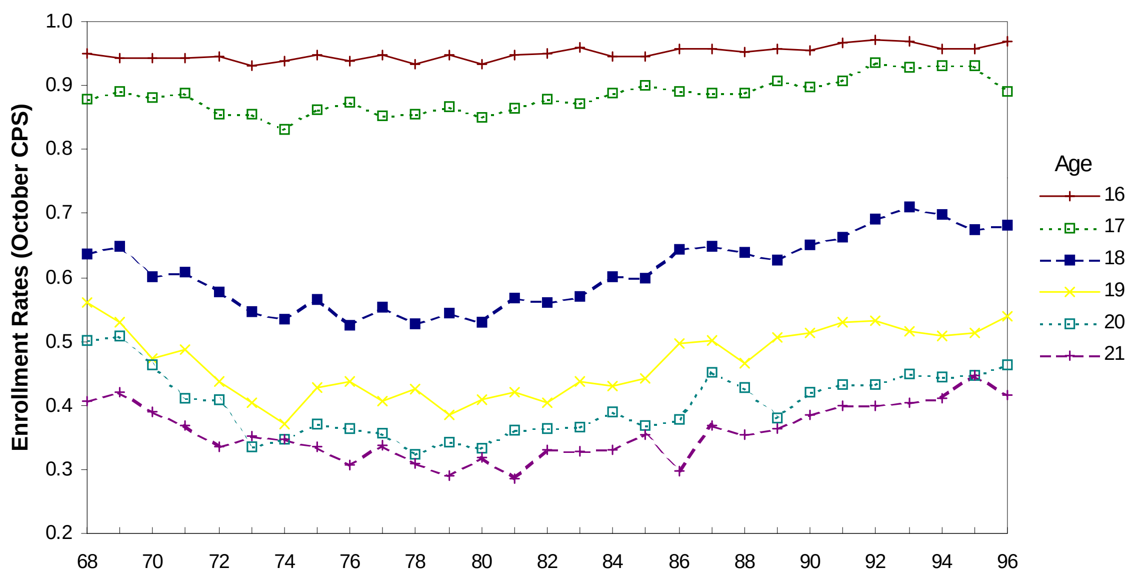
Table 8: Contribution of Changes in Returns to College and Cohort Size to Changes in College Entry Rate and Average Enrollment Rate of 19-21 Year Olds

	Men		Women		Returns to College (Per year)		
	College Entry Rate	Enroll Rate	College Entry Rate	Enroll Rate	Men	Women	Log of Cohort Size
1968	63.5	49.0	49.3	25.8	0.115	0.120	1.290
1978	51.3	35.3	49.6	31.0	0.073	0.081	1.450
1988	58.4	41.5	58.9	42.3	0.140	0.116	1.320
1996	61.5	47.3	70.8	48.9	0.136	0.151	1.200
Actual Changes:							
1968-78	-12.2	-13.7	0.3	5.2	-0.042	-0.039	0.160
1978-88	7.1	6.2	9.3	11.3	0.067	0.035	-0.130
1988-96	3.1	5.8	11.9	6.6	-0.004	0.035	-0.120
Changes Explained by Changes in Returns to College and Cohort Size:							
1968-78	-7.8	-8.1	-3.6	-2.7			
1978-88	10.9	11.4	3.1	2.3			
1988-96	0.9	0.9	3.0	2.2			

Notes: College entry rate is fraction of youth in college among those who were enrolled in 12th grade in the previous fall. Enrollment rate is average enrollment rate of 19-21 year olds. Explained changes use coefficient estimates from columns 4 and 8 of Table 7. See text.

Figure 1: Enrollment Rates of Young Men and Women by Age, 1968-96

A. Young Men



B. Young Women

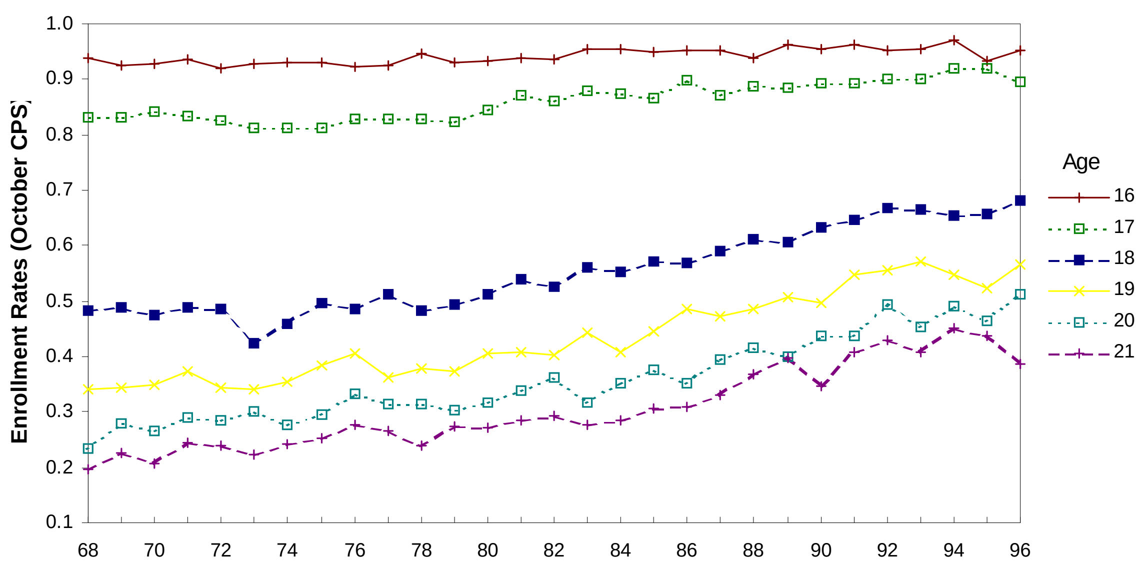


Figure 2: Enrollment Rates of 18 Year Olds By Race and Gender, 1968-96

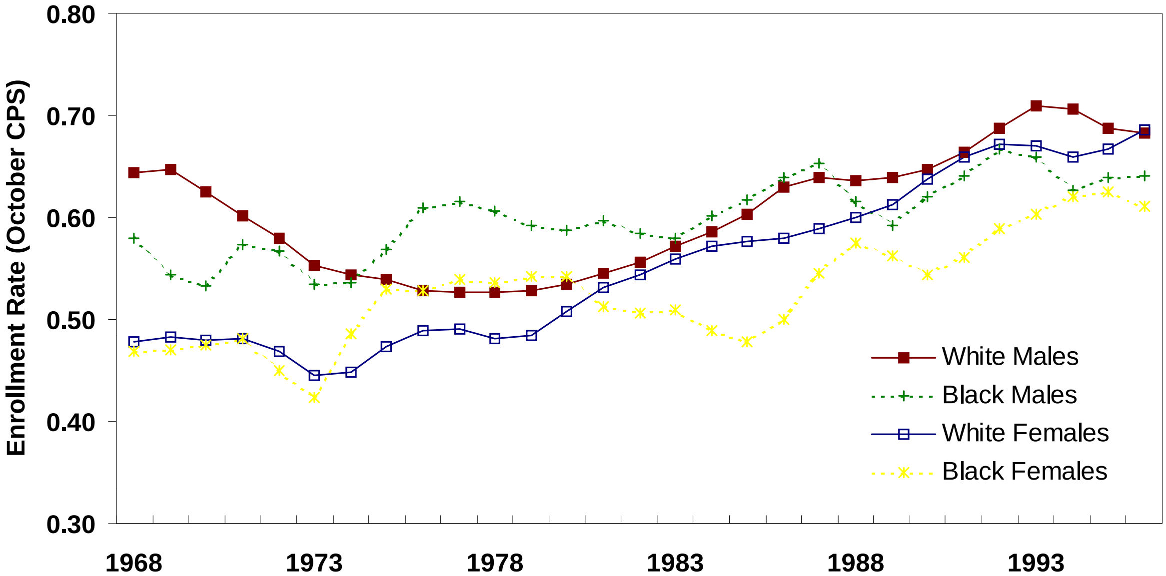
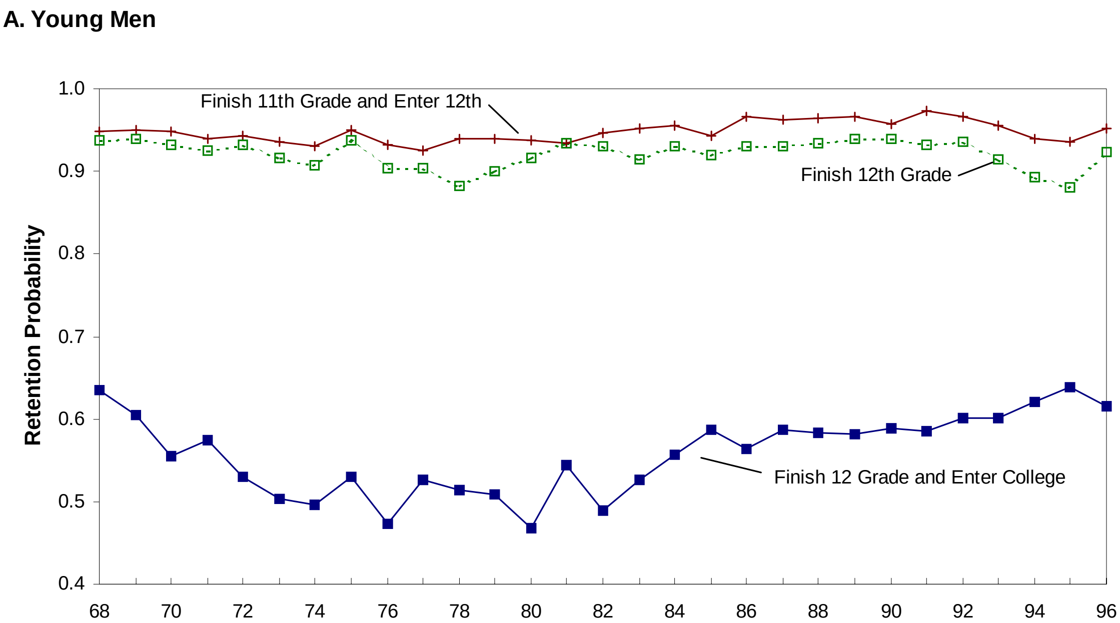


Figure 3: Grade Retention Rates for Young Men and Women, 1968-96



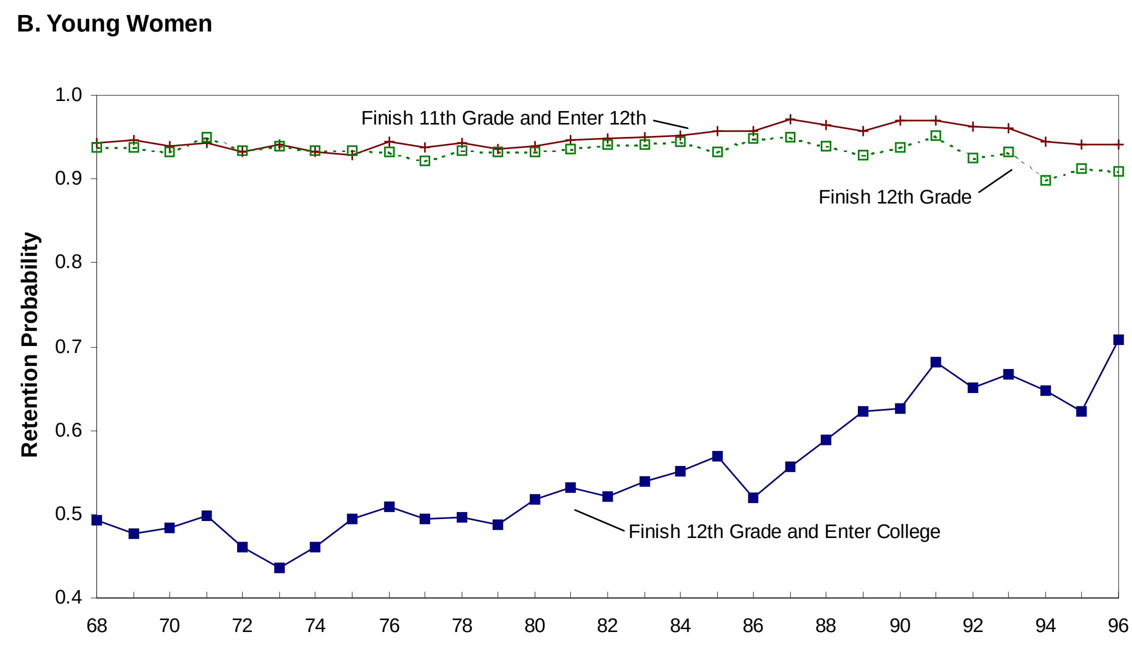
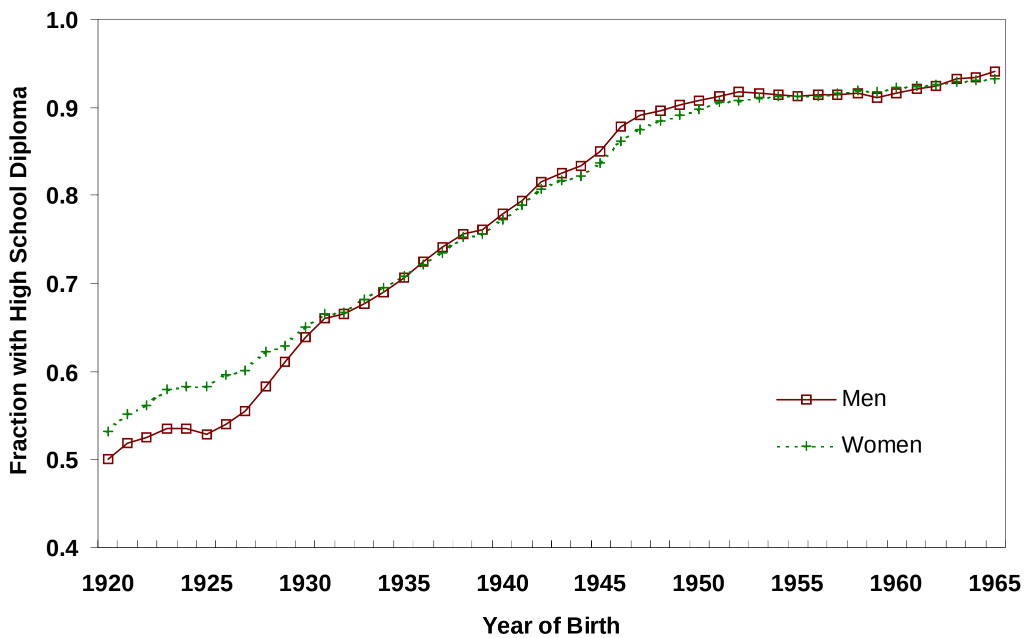


Figure 4: Estimated Educational Attainment of Cohorts Born from 1920 to 1965

a. Fraction of Cohort with High School Diploma by Age 40



b. Fraction of Cohort with College Degree by Age 40

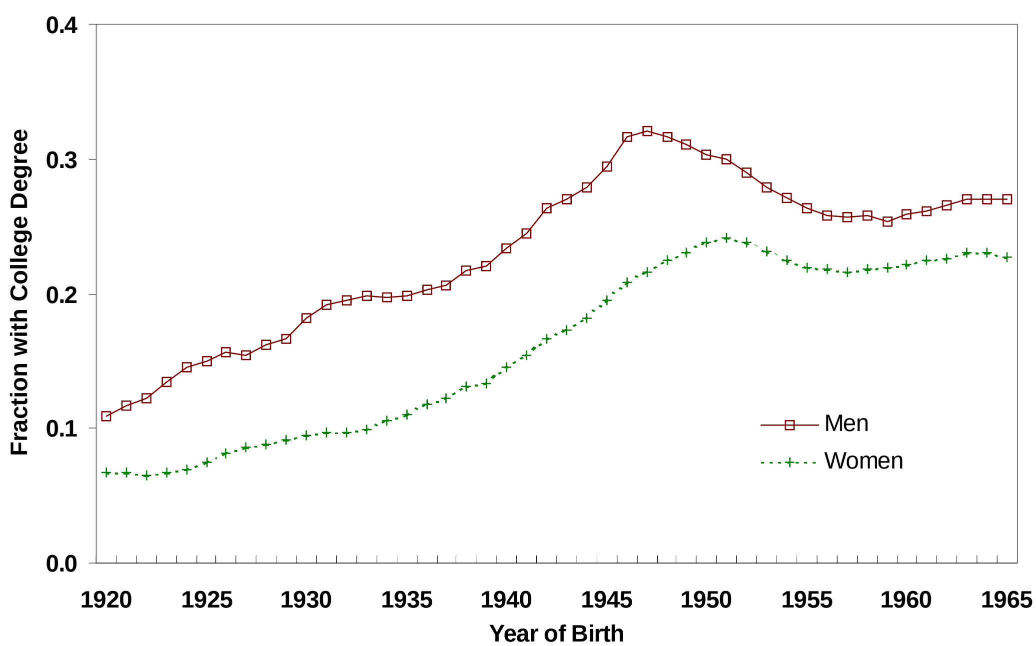
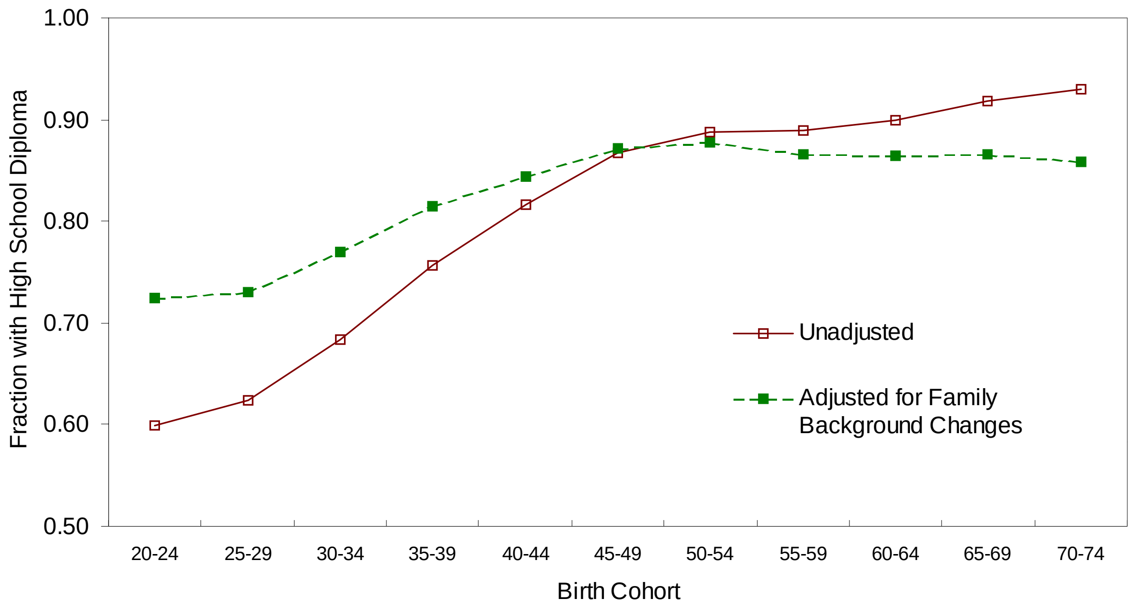


Figure 5: Estimated Fractions of Cohort with High School Diploma, Actual Versus Adjusted

a. Fraction of Men with High School Diploma by Age 30



b. Fraction of Women with High School Diploma by Age 30

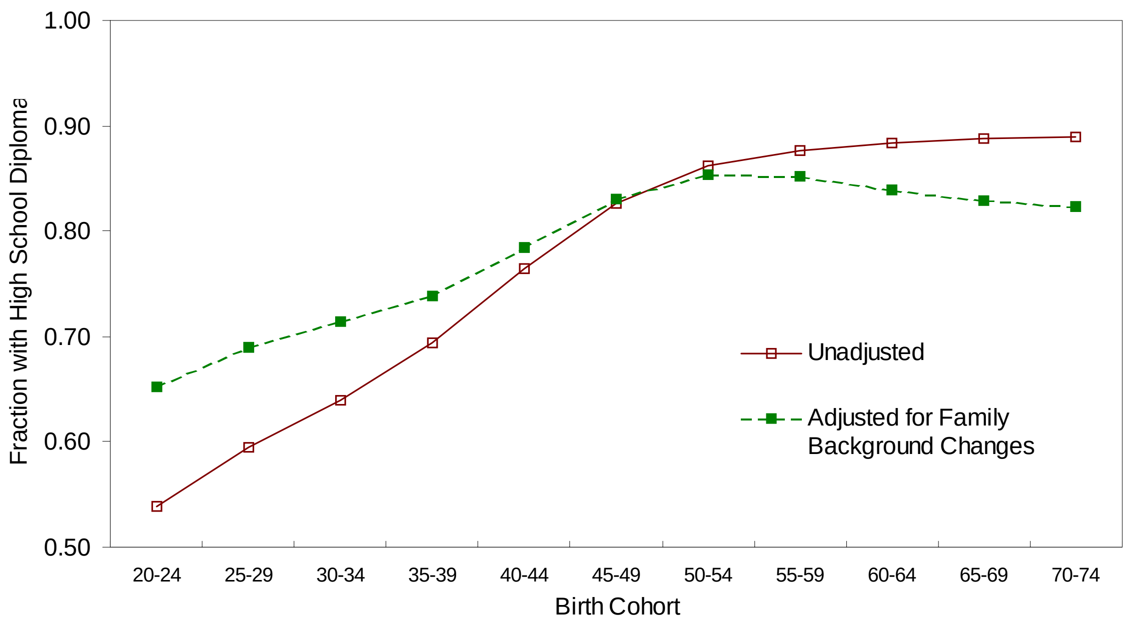
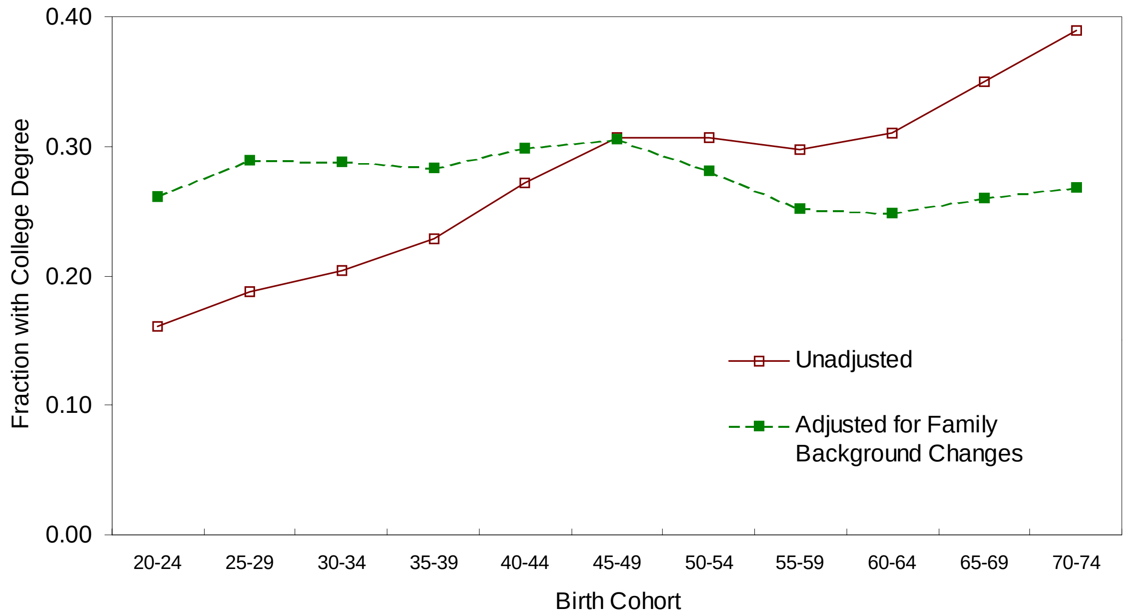


Figure 6: Estimated Fractions of Cohort with College Degree, Actual Versus Adjusted

a. Fraction of Men with College Degree by Age 30



b. Fraction of Women with College Degree by Age 30

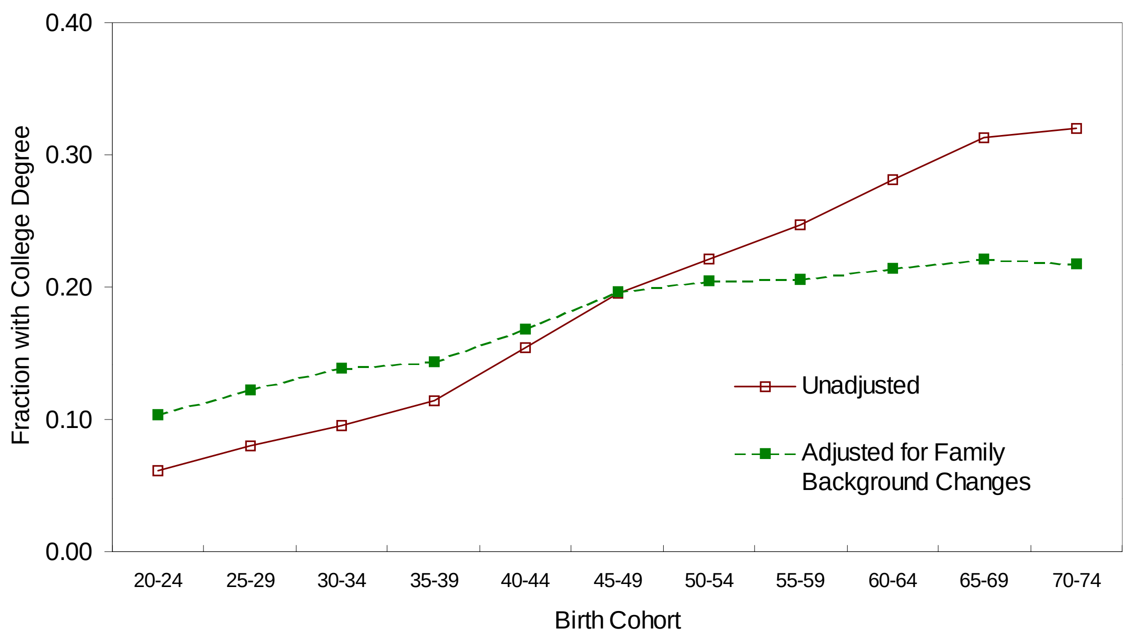


Figure 7: College Entry Rates of High School Seniors versus Cohort Size, 1968-96

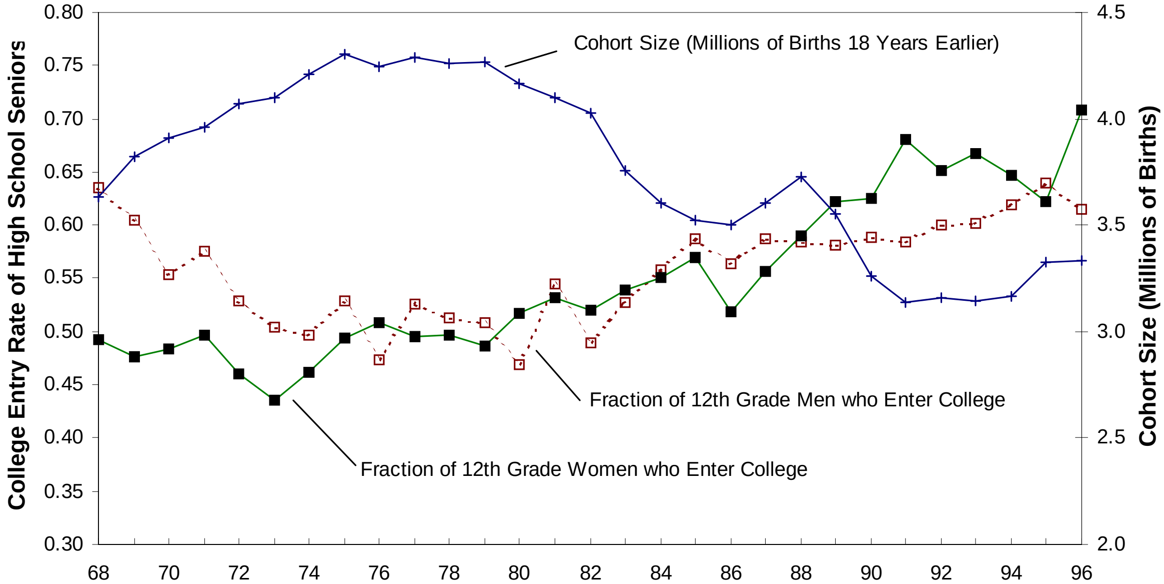


Figure 8: College Entry Rates of Young Men and Women, Returns to College, and Real Interest Rates