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ABSTRACT

This paper examines the determinants of GED acquisition, high school graduation and postsecondary training and schooling choices. Economic factors determining dropping out are considered. The determinants of high school certification by exam are fundamentally different from the determinants of ordinary high school graduation. GED graduates are more likely to take vocational and technical training while ordinary graduates are more likely to attend academic programs. GED recipients are much less likely to complete the post-secondary programs they begin. The GED exam does not measure the ability or motivation that predicts successful completion of post-secondary schooling and training programs. Participation in post-secondary nonacademic training is positively related to family resources. Thus both academic and non-academic training operate to reinforce initial family earnings inequalities.

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This paper examines the determinants of high school graduation, GED certification, and post-secondary participation in academic and vocational training programs. The three main avenues through which Americans attain high school graduate status are by attending traditional high schools, by attending adult high schools, or by passing the GED exam (General Educational Development exam). A traditional high school graduate must complete 12 years of school as well as a number of academic requirements to earn his or her degree. An individual who drops out of the traditional track can still earn a "high school equivalence" degree by GED exam certification. No formal academic requirements need to be satisfied for GED certification, and an individual who has left school at any grade level may take the exam. A dropout need only demonstrate a certain level of academic competence on the GED exam to earn high school certification. GED certification has grown from only 3% of all high school degrees awarded in 1965 to 14% during the 1980's. One in three traditional high school dropouts now earns a GED certificate. It has been widely assumed that GED recipients are equivalent to traditional high school graduates. In previous work, (Cameron and Heckman, 1993a) we demonstrate that exam (or GED) certified high school graduates make the same earnings as noncertified high school dropouts once we control for the number of years of high school completed. The only benefit to GED certification is the access it provides to a variety of federally-subsidized, post-secondary academic and vocational training programs that require a high school degree or its "equivalent" for admission.

This paper investigates the determinants of GED acquisition and high school graduation. We also consider the determinants of post-secondary training and schooling choices. We demonstrate two points: (1) The determinants of high school certification by exam are fundamentally different from the determinants of ordinary high school graduation. (2) In terms of their pursuit of post-secondary education or training, exam-certified (GED) high school graduates are fundamentally different from ordinary high school graduates. The former are more likely to take vocational and technical training; the latter are more likely to attend academic four-year colleges and complete the academic programs they begin. Exam-

certified graduates are much more likely to take some form of training than are non-certified dropouts. Our previous work demonstrated that GED-certified ability is not the ability valued by employers. In this paper we demonstrate that the GED exam does not measure the ability or motivation that predicts successful completion of post-secondary schooling and training programs.

In establishing these points, we present new evidence on the determinants and consequences of the early schooling decisions of American white, hispanic, and black males coming of age in the late 1970's and mid-1980's. We analyze school dropping-out and continuation decisions for these demographic groups.

This paper also examines the role of family background and local labor market opportunities on decisions to continue schooling and take training. Unlike traditional studies in the economics of education that focus on college choices, we disaggregate post-high-school educational and training choices to account for the full array of academic and non-academic schooling and training choices available to potential students. This disaggregation turns out to be essential in producing behaviorally interpretable models of post-secondary schooling choices for minority youth.

We find strong effects of family background on school continuation decisions. We also find that local labor market opportunities play an important role in explaining secondary schooling decisions and high school dropping-out behavior. The better are opportunities for unskilled labor, the lower are high school continuation rates. Participation in post-secondary non-academic training is positively related to family resources. Participation in either academic or non-academic training thus reinforces initial family earnings inequalities.

1. Background on the GED and The Recent Rise in GED Test Taking[1]

There are three main routes through which Americans achieve recognition as high school graduates: first, through traditional course attendance and graduation at the end of the 12th grade; second,

through night school, adult high school, and other formal programs oriented toward those who drop out of the traditional high school track but who still wish to achieve high school graduation; and third, through certification testing. Certification testing tries to validate knowledge gained through life-experience, and not just that gained inside a classroom. Several exam-certification programs exist, but certification through programs other than the GED has been small--only 1-2% of all new high school graduates over the period 1974 to 1987. The number of high school graduates from adult high school programs, too, has been small. The major change in the source of high school credentials has come from growth in GED certification.

Figure 1 documents the dramatic rise in GED certification. Cameron and Heckman (1993a) trace the growth of the GED beginning from its birth during World War II as a certification device through which military personnel could signal skills acquired in the military. The GED first became available to civilians in 1952. Cameron and Heckman (1993a) also discuss the rapid increase in GED certification beginning in 1965, when only 3% of all new high school diplomas were GED certificates, to the 1980's, during which over 14% of all new high school diplomas were GED certificates. They argue that the post-1965 growth began with direct subsidies from the Adult Basic Education Program - a program designed to teach basic reading skills to illiterate adults and help adult high school dropouts graduate high school, but continued growing in popularity as persons obtained GED certification to become eligible for a growing pool of State and Federal subsidies to participants in post-secondary academic and vocational education. These subsidies include direct cash grants, subsidized student loans, and subsidized work-study programs.

Exam certification also explains an anomaly in the data on high school completions. Figure 2 plots the proportion of traditional high school graduates for the cohort of 17-year-olds over the period 1951-1988. After a steady increase, the proportion declines after 1968 and then levels off through the late 1970's and 1980's. The pattern over the period 1971-1986 for all high-school-certified persons never

shows such a decline. The recent growth in exam certification explains the discrepancy. One in three high school dropouts now obtain a GED by age 25 (Cameron and Heckman, 1993a).

GED acquisition requires no classroom training, only the demonstration of a certain level of competence on the GED exam. GED examinees are tested on a total of 290 items in five[2] subject area tests: Writing skills (80 items), Social Studies (60 items), Science (60 items), Reading skills (40 items), and Mathematics (50 items). The test focuses on general knowledge (Malizio and Whitney, 1982). Most GED examinees spend little time in test preparation. A survey of GED test takers in 1980 revealed that the median examinee spent 20 hours preparing for the test and $10 in preparation costs. Seventy-five percent of the examinees spent 60 hours or less, and the upper 5% reported more than 200 hours in preparation. Twenty-one percent did not prepare in any way. The upper quartile of the candidates spent $30 in direct out-of-pocket expenses and lost salary. The pass rate on any given sitting is usually around 70%. Candidates who fail one or more sections may retake sections of the exam until all five sections are passed, though a two to three month waiting period is required by some states. Thus, most people sitting for the GED exam need little, if any, investment in new skills in order to pass. If the human capital investment required for GED certification is low, one might predict that the economic and educational returns to it might also be low.

2. Brief Description of the NLSY Data

In this section, we digress briefly to describe the National Longitudinal Survey of Youth (NLSY) data. The NLSY contains annual survey information on three separate samples of U.S. youths: a randomly chosen sample of 6,111 civilian youths; a supplemental sample of 5,296 randomly chosen black, hispanic, and non-black non-hispanic economically-disadvantaged youths; and a third sample of 1279 youth participating in active military service. Sample respondents were ages 13 to 20 in January of 1978, and were interviewed annually from 1979 through 1987. Thus, by the 1987 mid-year interview, ages ranged from 22 to 30. This data set is especially rich in detail on family background, military

participation, school and training histories, labor market histories and outcomes, as well as marriage and fertility histories.

Our sample consists of males who were in the random sample, the black supplemental sample, and the hispanic supplemental sample. From these samples a total of 3,003 observations are available from the random sample, 1,105 from the black sample, and 729 from the hispanic sample. Combining the blacks from the random sample and the blacks from the supplemental sample, we have a total of 1,461 randomly-chosen blacks. Similarly, we have 939 randomly-chosen hispanics. Finally, from just the random sample we have a total of 2,437 randomly-chosen non-black, non-hispanic youths.[3]

One advantage of the NLSY data is its rich variety of measures on family background, school quality, location, and ability. To measure family background we extract variables on the highest grade completed of the mother and father, income in 1978 of the respondent's parents, occupation of each parent, the number of living siblings, whether the respondent came from a broken home at age 14, whether the respondent was black, hispanic, or white, and regional labor market characteristics at each age starting at age 14. Since we can identify the state and county of each respondent for each sample year (as well as the state in which the respondent lived at age 14), we merged supplementary measures of county and state labor market conditions with the NLSY (see the Appendix). Finally, as a measure of ability, we use test scores from the Armed Services Vocational Aptitude Battery, administered to all NLSY respondents in 1980. This test is described in the Appendix. Precise definitions of the family background, local labor market, and school quality variables used in this analysis are listed in Table 1.

3. Basic Features of The Data

This section presents simple mean-difference and univariate distributional comparisons among high school dropouts, GED recipients, and high school graduates. Using the NLSY data described above, we compare the determinants and labor market and educational consequences of the three types of high school certification status.

Table 2 reveals that family background and labor market opportunity variables are ordered in the expected direction. High school dropouts are more likely to be minority group members and come from larger families with lower incomes and less educated parents than do GED recipients who, in turn, have more adverse background characteristics than high school graduates.[4] Dropouts are more likely to take unskilled jobs than are GED recipients and traditional high school graduates. The Wilcoxon test (see Bickel and Doksum, 1977) reported in the right two columns of Table 2, reveals that the family income distribution of traditional high school graduates stochastically dominates that of GED recipients and dropouts.

Evidence on post-secondary schooling choices is presented in Tables 3 and 4, which look at post-certification educational choices for both high school graduates and GED recipients. Table 3 shows first choices after completing certification. GED-certified persons are much less likely to attend four-year colleges and are more likely to enter the military or not undertake any post-secondary education. Table 4 reveals that GED graduates are less likely than high school graduates to attend four-year colleges, or graduate from them if they attend them. Completion rates at two-year colleges are much higher for high school graduates.

The evidence from the NLSY and the other studies reviewed in Cameron and Heckman (1993a) indicates that GED recipients are not the equivalent of high school graduates. Their labor market outcomes and performance in the military suggest that GED recipients are similar to high school dropouts. GED recipients are less likely to pursue post-secondary academic education and are less likely to finish an education or training program if they begin it. The balance of the paper presents a more refined statistical analysis of the NLSY that supports these basic conclusions concerning post-secondary education.

4. The Determinants of Secondary School Graduation, Dropping-Out Decisions, and GED Certification

This section presents an analysis of secondary schooling decisions through high school

certification. Section 3 considers the determinants of post-secondary educational decisions. We establish the following results:

(a) The determinants of the decision to take the GED are not the same as the determinants of high school graduation; accordingly, it is inappropriate to aggregate GED recipients and conventional high school graduates in studies of the determinants of secondary schooling.

(b) Parental education plays an important role in school attendance and completion decisions; father's education plays an important role in determining GED acquisition by dropouts; mother's education is inconsequential.

(c) Family income plays an important role in determining formal schooling decisions but not in determining GED acquisition decisions.

(d) Children from broken homes are less likely to graduate high school; the effect of a broken home on GED acquisition is much weaker.

(e) Better opportunities in unskilled labor markets encourage school dropping-out decisions and inhibit acquisition of a GED.

(f) There are pronounced differences in schooling determinants among racial/ethnic groups; even controlling for ability as measured by the Armed Forces Qualification Test (AFQT), it is not possible to combine the models determining secondary education for racial/ethnic groups.

Tables 5A-5D report estimates of logistic secondary school attendance and transition probabilities following Mare (1980). The tables present separate and pooled estimates for samples of NLSY white, black, and hispanic males. Table 5A reports estimates for the combined sample, and Tables 5B-5D show separate estimates for black, hispanic, and white samples, respectively.[5]

The first column reports the determinants of ninth grade completion. (Since virtually all individuals in the NLSY complete the earlier grades, analysis of lower-grade transitions is not worthwhile). The reported coefficients are the effects of unit changes in the associated variables on the log-odds ratio for completing ninth grade. The second column reports estimates of the determinants of transitions from ninth grade to high school attendance. The sample used to estimate this transition probability consists of those who completed ninth grade. The third column reports estimates of high school certification obtained either through taking a conventional high school diploma or through the GED. In our sample, more than 91% of all GED achievers had completed ninth grade. Finer disaggregation of the data by grade within high school is not empirically fruitful. Accordingly, the base state for these final secondary transitions is "attend high school."

For completion of 9th grade and the transition from 9th grade to high school, the grade attainment probability is

$$P = \frac{\exp(x\beta)}{1 + \exp(x\beta)}.$$

For transitions from "attend high school" to "graduate high school" (state 1) or GED (state 2) the probability of transition to state i is

$$P_i = \frac{\exp(x\beta_i)}{1 + \exp(x\beta_1) + \exp(x\beta_2)} \qquad i = 1,2$$

while the transition probabilities to the other states are defined analogously. Observe that

$$\ln(\frac{P_i}{P_j}) = x(\beta_i - \beta_j)$$

The coefficients in all models are measured relative to the drop-out state.[6]

In the combined sample, family income plays a powerful positive role in each probability of attainment and transition, except for the transition from "attend high school" to "obtain GED". Mother's

education plays a similar positive role. Father's education plays a more powerful role than mother's education, both in terms of its effects on log-odds ratios and in terms of statistical significance. Broken-home status plays an important negative role in later transitions but is not a statistically strong determinant of GED attainment.[7] The number of siblings exerts a strong negative influence in early schooling attainment and transition equations, but not in the later ones. As opportunities in unskilled work (county average earnings in unskilled jobs) improve, males are less likely to complete schooling.

Since comparing point estimates of parameters in a nonlinear model can be misleading, the magnitude of these effects is illustrated by simulations in Table 6 for each transition and for each racial-ethnic group. The first column of panel A shows the effect of a 33% increase in parents' family income on the probability of completing grade 9. The second column shows the effect of a 33% increase in parents' family income on the probability of attending high school given grade 9 completion. This effect is decomposed into two parts: a carry-over effect and an own-effect. For the first transition it is defined in the following way. Let $P_9 \cdot P_{AHS/9}$ denote the probability of attending high school (the probability of completing 9th grade times the probability of attending high school given 9th grade completion), and let $\widetilde{P}_9 \cdot \widetilde{P}_{AHS/9}$ denote the probability associated with a change in one or more of the explanatory variables. The total change in the probability is $\widetilde{P}_9 \cdot \widetilde{P}_{AHS/9} - P_9 \cdot P_{AHS/9}$ and can be decomposed[8] into $\widetilde{P}_9 \cdot [\widetilde{P}_{AHS/9} - P_{AHS/9}] + P_{AHS/9} \cdot [\widetilde{P}_9 - P_9]$. The first term is the own-effect associated with the change in the probability of attending high school given the probability of 9th grade completion, and the second term is the carry-over effect reflecting the increase in the probability of attending high school arising from an increase in the probability of completing the 9th grade. More generally, carry over effects are defined in the following way. If i is the origin state and j is the destination state, P_{ij} is the probability of making the transition. Let "0" denote the base state. The probability of attaining state ℓ is

$$P_\ell = P_0\left[\sum_{w=1}^{W}\prod_{s=1}^{I_w} P_{w(s),w(s+1)}\right]$$

where I_w = the number of steps in path w starting from 0 and ending in ℓ, and s is the step in the path associated with state w(s) and W is the number of paths that start from "0" and end at ℓ. A path is indexed by w(s), w(s + 1),...,etc., the transitions that define it (the same intermediate state may appear in several paths). Let "~" denote the new value of the associated probability that results from changing conditioning values of the covariates. The total change in the probability is $\tilde{P}_\ell - P_\ell$. The carry-over effect for destination ℓ is defined to be

$$\sum_{w=1}^{W}\left[\tilde{P}_0\left(\prod_{s=1}^{I_w-1}\tilde{P}_{w(s),w(s+1)}\right) - P_0\left(\prod_{s=1}^{I_w-1}P_{w(s),w(s+1)}\right)\right]P_{w(I_w-1),\ell}\,.$$

In the tables we express this a percent of the total change in probability ($\tilde{P}_\ell - P_\ell$). This terms measures the effect of a change in the regressor on the state probabilities of being eligible to make the next transition into state ℓ weighted by the base transition probabilities (evaluated at the base level of the regressors). It is an index of the importance of the change in the regressor as it operates through the history of the process leading up to the transition indicated by the column heading.

The table illustrates some interesting differences between race groups. All groups are sensitive to changes in variables representing family resources (see panel A for family income and panel B for the number of siblings), though hispanics are much more so than blacks or whites. This is true at the initial sorting out stage of "Complete 9" and at "Attend High School" and "Graduate High School." For the high school graduation decisions of all groups, only a small portion of the influence of family income can be attributed to the carry-over effect (between 10% and 27%). Family income affects high school graduation primarily through the decision to graduate high school once the individual has decided to attend high school (the own-effect). These results are consistent with a simple economic model. Family

resources (as measured by family income) positively affect schooling, suggesting that credit markets for human capital are less than perfect. Competition for family resources (as measured by the number of siblings) reduces schooling opportunities for an individual.

Responsiveness to the unskilled wage rate is another indirect measure of the influence of the family resource constraint. As opportunities for low-skilled labor rise the demand for additional schooling declines. Again, initially and at each transition hispanics are much more responsive than blacks or whites to change in the opportunity wage of attending school (panel C). For the decision to graduate high school, whites show little response to changes in this variable; most of the influence comes through the carry-over effect (55% of the total or about a percentage point change in the probability). Blacks are more than twice as responsive as whites, with most of the impact coming at the transition to "Graduate High School" (the carry-over effect for blacks is also about 1 percentage point). For hispanics a substantial carry-over (a 4 percentage point increase in the probability) is compounded by a large own-effect (about an 8.5 percentage point increase in the probability).

Parental education represents measures of family permanent income not captured by other measures of family resources, as well as direct measures of environmental influence and parental investment in children. The effects of these variables are exhibited in panels D and E. Parental education influences the schooling decisions of young blacks and whites about equally and more strongly than young hispanics, who as noted above are most sensitive to changes in unskilled job opportunities and family resources. For hispanics, the small influence these variables have on the high school graduation decision comes mainly through the carry-over effect.

Since decisions to take the GED are often made in the late-teens and early twenties, parental resources and influences are less important in shaping this decision. In general, the sign of the GED response is ambiguous. For example, an increase in family income will not only increase the number of dropouts seeking a GED or high school graduation, it will also increase the number of potential GED

recipients who choose to complete high school instead. Furthermore, since parameter estimates were obtained from a small sample of GED recipients, we must exercise care in interpreting these numbers. Increasing family resources (panels A and B) decreases the number of GED recipients (more individuals go on to complete high school instead). Reducing the unskilled opportunity wage increases GED recipiency. Increasing parental education has an ambiguous though inconsequential impact.

Tests of equality of the coefficients of the transition probabilities - from "attend high school" to "graduate high school" and "obtain GED" are rejected for the combined sample for each racial/ethnic sample--black, hispanic, and white. In this sense, the two states are not equivalent.[9] Table 5E reveals the consequences of pooling "GED attainment" and "high school graduation" as final destination states. The pooled samples clearly distort the GED attainment equations. In the pooled estimates, estimated family background and resource effects tend to weaken and sometimes become statistically insignificant in the pooled equations.

Although it is computationally convenient to aggregate racial/ethnic groups, the same model does not apply to whites, blacks, and hispanics. Family resource variables play a much weaker role in black schooling decisions than they do for whites and hispanics. Minority schooling decisions are more sensitive to opportunities in the unskilled labor market. Parental environmental variables play a much weaker role in the high school certification decisions of hispanics than they do for whites and blacks. The decision to take a GED from the dropout state is not systematically related to parental environmental, family resource, or labor market opportunities for whites, although labor market opportunities play an important role for blacks and hispanics, and parental environmental variables play an important role for blacks. The data reject the hypothesis of equality of the slope coefficients for the secondary schooling attainment model for all three racial/ethnic groups, and for any combination of pairs of those groups--black-hispanic, black-white, and hispanic-white.[10]

We do not report estimates of models analogous to those reported in Tables 5A-5D when ability

(AFQT score) is added to the model. It is an important variable (in the sense of having strong statistically predictive power) in high school graduation and GED certification decisions, as well as in the other educational attainment decisions. Its addition to the fitted models weakens the impact of parental background variables on high school certification decisions in the combined sample. It has the same effects on the family resource and parental background variables for whites and hispanics. In results not reported here, family resources and background variables are strong determinants of AFQT ability. Whether AFQT ability is a "cause" or a consequence of schooling is problematic.

When ability is added as a regressor, the hypothesis that the determinants of conventional high school graduation are the same as the determinants of GED attainment can still be rejected for each demographic group and for the combined sample. (All tests had a p-value lower than .01). Tests of equality for all three race groups and for each pair of the racial/ethnic groups reject the hypotheses at the conventional .05 level when ability is added to the model, except for the hypothesis that whites and hispanics can be pooled (the p-value is .14). In empirical work not reported here, we find that the addition of school quality variables does not systematically affect dropping out/continuation decisions when the baseline set of regressor variables for the model of Tables 5A-5D are included. Despite the changing structure of the returns to education documented by Murphy and Welch (1988), we find little evidence of structural changes in the school participation equations when the samples are split into a pre-1981 period and a post-1981 period.

The central conclusion of this section is that the determinants of the GED are not the same as the determinants of conventional high school graduation. However, given the relatively small size of the GED population, pooling GED and conventional high school graduation as destination states, does not substantially affect inference about the determinants of conventional high school graduation. Compare the columns of Tables 5E with the third columns of Tables 5A-5D.

5. The Determinants of Post-Secondary Schooling and Training

In the previous sections, we established that the determinants of GED acquisition are different from those of the traditional high school degree. This difference persists even when a standard measure of ability (AFQT score) is introduced into secondary schooling attainment. It remains to consider whether the GED has the same value as the traditional high school degree in predicting post-secondary schooling and training choices. The most commonly stated reason for taking a GED is to gain admission to some form of training or schooling program (Malizio and Whitney, 1981). The GED may signal ability to learn even if it does not predict ability to earn.

Using the model of educational attainment presented above, we find that the two forms of secondary school certification do not have the same predictive power for post-secondary college attendance and completion, even controlling for family background characteristics, labor market characteristics, and the AFQT measure of ability. This is so whether or not college attendance and completion equations are disaggregated by race/ethnicity. In this sense, the GED and the high school diploma are not equivalent in their predictive power.

The traditional educational attainment literature is preoccupied with academic post-secondary schooling and training. Individuals select from a broader menu of post-secondary options, including vocational schools and company training. Extending the conventional schooling attainment model to accommodate these extra schooling and training options produces a more interpretable model of post-schooling transitions in which the GED credential and the traditional high school diploma have equal predictive power in explaining the next transition taken after attainment of secondary credentials. However, GED-certified persons do not complete post-secondary schooling and training programs at the same rate as high school graduates. This evidence is consistent with the view that persons who wish to participate in post-secondary schooling and training programs obtain GED credentials but they are less successful than regular high school graduates in completing them.

Tables 7A-7D present estimates of the parameters of post-secondary college attendance probabilities for combined samples of whites, blacks, hispanics, and racially disaggregated samples. The combined sample (Table 7A) reveals a powerful role for family income, resource constraints (number of siblings), parental education, and labor market opportunities in explaining attendance of high school graduates at two-year and four-year colleges.[11] Controlling for parental background and family resources, blacks and hispanics are more likely to attend college although they are not more likely to graduate from four-year colleges.

These estimates are in sharp contrast with the estimates of parameters of the transition probability from "obtain GED" to "attend college". Family resource variables play no role in explaining that transition nor do labor market opportunity variables. Black GED recipients are less likely to attend college. Observe that no estimates of transition probabilities from "obtain GED and attend college" to "graduate college" are reported. Only two of the 336 GED holders in our sample completed four years of college by the end of the survey. Aggregation tests decisively reject the hypothesis that the transition equations to college are the same for GED recipients as they are for traditional high school degree holders.[12] Despite the fact that we reject the hypothesis of equality of origin states, there is little harm in pooling observations from the two states in estimating the determinants of the transition from traditional high school to college.[13] We also test the hypotheses that various race groups can be aggregated. These hypotheses are all rejected at a .01 significance level.

Disaggregating by race produces qualitatively similar findings for each race group but the coefficient estimates for blacks and hispanics are less precisely determined. Simulations in Table 8 illustrates the magnitude of these effects. Parental education plays an important role in high school graduation to college attendance decisions, particularly for black and white youth. For hispanics, the influence of these variables is relatively small, as it was for the high school graduation decision. For blacks and whites these variables are important in determining college completion and post-college

education as well, though the majority of the influence operates through the carry-over effect[14] (columns 3 and 4 of panels D and E). Family resources (Panels A and B) and opportunity wages (Panel C) also play an important role in all post-secondary transitions (except for GED recipients' college attendance decisions). Most of the influence of these variables here, too, comes indirectly through the carry-over effect. Exclusive focus on transition equations (as opposed to attainment equations) understates the contribution of income, parental education, and local labor markets to minority college attendance.

The estimates for the combined sample and the results for whites produce the anomalous result that GED-certified persons from broken homes are more likely to attend college. Such statistical results are a possible sign of uncontrolled selection bias. The results displayed in Table 7A-7D do not control for selective participation in higher grades of schooling. Those persons who come from broken homes and complete the GED may be more motivated to attend college. Estimates controlling for attrition bias due to unobservables, using a nonparametric method described in other work (Cameron and Heckman, 1992b and 1993b) reveal the same general patterns of coefficient size and statistical significance as appear in the estimates in Tables 7A-7D.[15] In particular, the anomalous results for broken home remain in a variety of specifications.

In results not reported here, addition of the AFQT ability variable to the model reported in Tables 7A-7D does not reverse the sense of any of the statistical tests regarding the nonequivalence of GED and high school graduation as origin states for college attendance, or the tests regarding the nonequality of the coefficients for the different race groups. The main effect of the addition of the AFQT variable to the base set of regressors is to weaken the size and statistical significance of family income and family background variables.

While it is conventional to focus on collegiate post-secondary schooling, it may be misleading to do so. Many persons who take the GED do so to gain admission to non-collegiate vocational and technical training or to satisfy educational requirements posted by business establishments. We previously

noted that GED recipients and traditional high school graduates were equally likely to attend two-year colleges, but GED recipients were much less likely to attend four-year colleges.

Tables 9A-9D present evidence on the effects of family resources, family background, and labor market alternatives on the first transition taken after high school certification achieved through a GED or through a traditional diploma. We consider attendance at a four-year college, a two-year college, a vocational-technical school, a job with company training or an apprenticeship program, enlistment in the military, or a job without any formal training. The benchmark state is "not working". For the combined sample (Table 9A) or for the separate race/ethnic groups, we do not reject the hypothesis that the origin state (GED or traditional high school graduate) is irrelevant in explaining these transitions. The P-values of the tests are .18, .21, .28, and .31 for the combined, black, hispanic, and white samples, respectively. However, we reject the hypothesis that race groups can be combined in the manner of Table 9A.[16] The results in Tables 9A-9D, taken as a whole, are more behaviorally interpretable than the results in Tables 7A-7D. For example, the perverse effect of broken-home status disappears in a model which considers a broader portfolio of post-secondary choices. Table 11 displays simulations results corresponding to the estimates reported in Tables 9A-9D.

Family income effects are important not only for college attendance but also for participation in formal on-the-job or apprenticeship training programs and work without formal training. Vocational training, two-year college, and the military offer an escape from credit constraints: decreasing family income increases the likelihood an individual will either enter the military or take vocational training, and has little or no effect on the probability of two-year college attendance. Individuals with lower family incomes are less likely to attend four-year college, take company training, or work. Similar conclusions hold when we decrease the number of siblings and the demands on family resources fall. The largest part of the influence of the variables on four-year college, work, and company training - apprenticeship decisions operates through the own-effect and not the carry-over effect. Furthermore, since the carry-

over effect associated with these variables for the chances of graduating high school is positive (and inconsequential for GED recipiency), the own-effect is substantially negative for the transitions from complete high school to military, vocational training, two-year college, and the no work state.

Changes in the opportunity wage matter, too. As average earnings in low-skill industries fall, individuals are more likely to enter two- or four-year college, vocational training (off-the-job), or the military, and less likely to obtain work, an apprenticeship, or other company (on-the-job) training. Non-financial factors influence decisions in the expected directions. Individuals whose parents have achieved less education are less likely to attend two-or four-year college and more likely to take non-academic training, no training, or enter the military. The same general patterns appear for each race/ethnic group. In results not reported here, inclusion of the AFQT ability measure generally weakens the size and statistical precision of the estimated family background variables, but does not reverse any qualitative conclusions - except (a) the black and hispanic variables become positive and statistically significant in the college attendance equations (two and four year colleges); and (b) race/ethnic differences in first transitions after completing secondary certification tend to weaken.

One main result of this section is that there is no distinction between the GED and the traditional high school diploma in predicting the first choice taken after secondary schooling in a broader model of post-secondary choices. One can reject equality of the two forms of high school certification in predicting college choices estimated in the more traditional and restrictive model that lumps non-collegiate choices into a common state. As a practical matter, there is little harm in combining GED attainment and ordinary high school graduation if one is interested in analyzing the determinants of the transition from traditional high school to attending college.

6. Summary and Qualifications

This paper presents basic facts about the determinants of alternative routes to traditional high

school graduation. We consider the economic and behavioral causes of GED certification.

We find that the determinants of traditional high school certification are different from the determinants of exam-certification. Elsewhere (Cameron and Heckman, 1993a), we establish that the economic consequences of the two types of certification are different. We also find that the GED and the traditional high school diploma are not equally good as predictors in conventional college attendance and completion models that combine non-collegiate choices into a single choice state. This finding is consistent with considerable anecdotal evidence. However, in a richer model of post-secondary schooling choice that recognizes the variety of nonacademic training options available to youth, the two forms of certification are equally as good in explaining the first choice persons make after obtaining certification at the secondary level. Vocational training programs, two-year college, and the military appear to operate as alternatives that enable persons to evade credit constraints. Participation in company training, four-year college, and work increases with family wealth and resources.

Appendix

Introduction

This appendix contains three supplemental discussions regarding the data used in our analysis. Section 1 describes the NLSY data we use for the analysis of schooling choices. Section 2 describes the county average earnings variable. Section 3 describes the AFQT score.

1. Data for the Analysis of Schooling Choices

In this section we describe the family background and income measures and the schooling transition variables. To ascertain secondary school quality, we use measures of the number of full-time equivalent teachers per student, percent of faculty with graduate degrees in schools, and whether a student attended a public or private school (including parochial schools).

One limitation of the NLSY is that data on parents' family income is less than ideal. For about 10% of our sample, Family Income had missing values for one of two reasons: first, because of invalid skips in the interview, and second, because the family income questions pertained to the respondent's family and not that of his parental family. If an individual lived with his parents or was at school living in a dorm or other student housing, a troop barracks, aboard a Navy ship or in other military quarters, hospital, jail, or juvenile detention center, then reported family income was that of his parent's household. In fact, the income questions were asked of the individual's parent or guardian. If an individual lived in his own housing, an orphanage, a convent or monastery, then reported family income was for his residential family (a type "C" interview) not his parental family. We tried to gauge the importance of the problem by imputing family income and flagging the imputed observations with a binary variable. We found no effects of the dummy in a series of estimated behavioral equations; nonetheless, the observations with imputed income were dropped.

Another two percent of the potential sample was deleted because of missing values in the highest grade completed variable for the mother or the father. Even individuals from a broken home were likely to report a highest grade completed for both parents.

We used highest grade completed and highest grade attended in 1987 to determine the level of school attainment. Individuals were ages 22 to 30 in that year. In addition to knowing highest grade completed and attended and whether an individual was enrolled in school in 1987, we know whether the individual has a college degree by 1985. This variable was used to determine any discrepancies in computed highest grade completed. Finally, for those who obtained a GED, a moderate number reported having attended college before receiving the GED. These people were taking GED preparation courses at community colleges, and we did not count them as having attended unless they attended college after obtaining the GED.

The first post-secondary transition records the first four-year-college, two-year college, vocational school, company training or apprenticeship program enrolled in within four-years after high school graduation or GED recipiency. Few individuals undertake new academic or vocational training after this period, according to our data. Furthermore, there is little overlap between programs in subsequent transitions except that about half of individuals taking a vocational training course took at least one more vocational program in the four-year post-graduation period and approximately one fourth of vocational school entrants later enrolled in a two-year college and vice versa. Individuals who took none of these programs but held a full-time job (more than 20 hours per week) for at least one-month were counted as "working." All others were counted as not working. Other definitions dividing working and not working failed to produce any consequential differences in our results.

2. Data on Local Labor Market Conditions

We describe the County Average Earnings variable in this section. We merged into the NLSY a supplementary data set from the Bureau of Economic Analysis[1] containing more detailed measures of

labor market conditions by industry for the years 1969 to 1986. These data, collected from state unemployment insurance programs, contain measures of total full-time and part-time employment and earnings both in the county and state for each major industry. Using these measures, we constructed variables for average earnings per job for each skilled industry by county and state for each individual in the NLSY.

For the first schooling transition--9th grade completion--and transitions from 9th grade to attending high school, and from attending high school to either receiving a High School Diploma or obtaining a GED, we construct a measure of average earnings per job in the unskilled sector as an opportunity cost of schooling. Since our data were broken down by industry, we used average earnings in the service, retail, and wholesale industries to proxy for unskilled wages. As an opportunity cost of college entry we use average earnings in manufacturing, construction, mining, transportation, and public utilities. For the opportunity cost of completing college we use average earnings in finance, real estate, and government (excluding the military).

3. Armed Services Vocational Aptitude Battery

In 1980, the Armed Services Vocational Aptitude Battery (ASVAB) was administered to NLSY respondents, with a completion rate for the total sample of approximately 94%. The NLSY respondents were ages 16 to 23 when the test was taken. Groups of 5 to 10 persons were tested at more than 400 sites throughout the country, and each individual was given a 50 dollar honorarium for completing the test.

The ASVAB consists of a battery of ten tests: general science, arithmetic reasoning, word knowledge, paragraph comprehension, numerical operations, coding speed, auto and shop information, mathematics knowledge, mechanical comprehension, and electronics information. The military uses ASVAB scores to determine eligibility and assignment qualifications for new enlistees. In particular, the Armed Services Qualification Test (AFQT) sums word knowledge, arithmetic reasoning, paragraph

comprehension, and one-half of numeric operations. The AFQT is considered a general measure of trainability and is a primary criterion for enlistment eligibility for the Armed Forces. It is the measure of ability used in our analysis.

Footnotes

1. Cameron and Heckman (1993a) present a more detailed overview of the history of the GED.

2. Since 1990 an essay section has been added to the GED battery.

3. This sample includes a small number of men of Asian origin.

4. The anomalously high number of siblings is a consequence of size-biased sampling in the NLSY. If one child is included in a unit, so are all of his/her siblings - provided they share common family characteristics. This sampling induces a stochastic dependence among sibling observations which we have analyzed elsewhere (and Heckman, 1992a) where we show it has a minor effect on the estimated standard errors of coefficients of wage equations.

5. The combined sample is not a representative random sample because both blacks and hispanics are overrepresented. Nevertheless, the slope estimates of a logit are robust with respect to such oversampling and represent consistent estimates of population parameters (Cosslett, 1981).

6. The consequences of correcting for selective sample attrition (arising from serially correlated unobservables in schooling transition equations) is briefly discussed in section 3 and is extensively discussed in Cameron and Heckman, 1992b and Heckman, 1993b.

7. A more natural specification interacts father's education with broken-home status, but there is no strong statistical support for this interaction and when it is entered, it does not reverse any conclusion in this paper.

8. An alternative decomposition weights the own-effect by P_9 rather than $\widetilde{P}_9$, and the carry-over effect by $\widetilde{P}_{AHS/9}$. The difference between the two decompositions is minor.

9. These tests are not reported here. The highest p-value of any of these tests was .005. We tested both equality of slope coefficients and equality of both slopes and intercepts. These are tests of the necessary conditions for the two states in a multinomial logit model to be the same, except for a random (iid Weibull) error. A better test would consider collapsing the two states into one but this entails

inference about boundary values of parameters. If these states are aggregated into a univariate logit, the resulting model is decidedly inferior in predicting GED + high school graduation decisions. Estimates from the more general multinomial probit model support the estimates reported here.

10. These tests are not reported here. The p-value of pooling all three groups was .001. The highest p-value for the tests pooling any two of the three race group was .015 for the test of equality between hispanics and whites.

11. Recall that the slope estimates are consistent estimators of the population parameters.

12. The largest p-value among the tests was .03 for hispanics.

13. This table was deleted for the sake of brevity but is available from the authors upon request.

14. See footnote 15 for a caveat about results for the last two transitions.

15. The two major exceptions occur for the transitions to graduate college and to attend 17 or more years of school. Using the same model but a different set of data, and Heckman (1993b) use nonparametric methods to control for selection bias and find much larger and more reasonable estimates transition parameters of these last two transitions. They also present a specification analysis detailing the consequences of not controlling for unobserved variables.

16. The p-values for the tests combining blacks, hispanics, and whites was .00, with or without the AFQT score. The test combining blacks and hispanics was .03 (.13 with the AFQT included). The test combining blacks and whites had a p-value of .00 (.01 with the AFQT), and .01 (.12 with the AFQT) for the test combining hispanics and whites.

Notes to Appendix

[1]We would like to thank Joe Hotz and Seth Sanders for supplying us with the tapes and documentation for these data.

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Table 1

Definitions of Variables Used in School Transition Analysis

Number of Siblings	Number of living siblings
Family Income	Total family income of members of the parents family living in the household at the time of the first interview. Includes salary, interest and dividends, social security and retirement, alimony and child support, rental income, pension and annuities, unemployment compensation, veterans benefits, public assistance and welfare, business income, farm income, educational benefits, food stamps, AFDC, and gift income (denominated in 1000s of 1990 dollars).
Highest Grade Father and Mother	Highest grade completed in years by the respondent's father or mother when respondent was age 14.
Broken Home	Absence of at least one parent from the respondent's household at age 14.
South Age 14	Whether the respondent lived in the Southern census region at age 14.
Farm Age 14	Whether the respondent lived on a farm at age 14.
County Average Earnings	The average earnings per job (1000's of 1990 dollars) in skilled or unskilled industries in the county of residence measured at the time the individual first became at risk for the next transition. For example, for the transition complete grade 9 to attend high school, County Average Earnings is unskilled average earnings measured in the year the individual completed grade 9. For whether the individual completes grade 9, the initial state, county average earnings is unskilled average earnings measured in the year the individual first attends grade 9 or the year they dropout if they never attend grade 9. As education level improves, so does the imputed opportunity wage. See the Appendix for more details.
AFQT Score	Score on the Armed Forces Qualification Test (see the Appendix).
Company Training/ Apprenticeship	Any on-the-job, company-sponsored vocational or technical training program or formal apprenticeship that lasted at least one month.
Vocational Training	Any off-the-job vocational or technical training program (may or may not be paid for by an employer) taken at a vocational school, nursing school, flight school, business or secretarial college, barber school, or beauty college. The program must have lasted at least one month.
Military	Enlistment and active duty for at least one month in any full-time branch of the armed forces.
Two-Year College	Full-time enrollment for at least one full month in a junior or community college.
Four-Year College	Full-time enrollment for at least one month in a four-year college or university.

Table 2

Mean Family Background Characteristics and Wilcoxon Tests of Equality

	Means (Standard Error of the Mean)			*Probability > Chi-Square*	
	Dropout	*GED Recipient*	*HS Graduate*	*Dropout vs. GED*	*GED vs. HS Graduate*
Family Income (1990 $'s)	24930 (518)	29838 (839)	39557 (383)	.00	.00
Highest Grade Completed by Father	8.6 (.12)	10.3 (.16)	12.2 (.06)	.00	.00
Highest Grade Completed by Mother	9.6 (.10)	10.6 (.12)	12.0 (.04)	.00	.00
Number of Siblings	4.3 (.09)	3.4 (.10)	3.0 (.04)	.00	.00
Broken Home	.29 (.02)	.26 (.02)	.13 (.01)	.55	.00
Black	.22 (.01)	.19 (.02)	.12 (.01)	.36	.00
Hispanic	.14 (.01)	.09 (.01)	.05 (.00)	.02	.00
N (Proportion of Total Population)	884 (.183)	468 (.097)	3485 (.720)	NA	NA

NA = Not Applicable

Note: The sample consists of individuals interviewed in the initial 1979 wave and the 1987 wave of the NLSY. The means are weighted to account for oversampling of the Black and Hispanic populations. Only the random sample portion of the data was used to construct the Wilcoxon tests.

Table 3

Random Sample NLSY
* Means of the Training Graduating High School or Obtaining a GED

First Training Action After Completing High School Degree

(Standard Errors of the Mean)

	Attend 4 yr College	*Attend 2 yr College*	*Vocational Training*	*On The Job Training/ Apprenticeship*	*Military*	*Other**
Graduate High School (N = 2925)*	.38 (.01)	.23 (.01)	.08 (.00)	.05 (.00)	.05 (.00)	.21 (.01)
GED (N = 304)*	.13 (.02)	.22 (.03)	.13 (.02)	.05 (.01)	.10 (.02)	.37 (.04)

*Other = Work with no Training, Unemployment, Out of Labor Force.
Note = See the footnote of Table 3 for the sample inclusion criteria. The means are weighted to account for minority oversampling.

Table 4

College Education After Receiving High School Degree
(Standard Errors of the Means)

Panel A

	First Enter Four Year College	*First Enter Two Year College*	*No College*
H.S. Diploma	.37 (.01)	.23 (.01)	.40 (.01)
GED	.10 (.02)	.20 (.02)	.69 (.02)

Panel B

Completion Rates For Four Year College Starters"

	Complete 4 or More	*Complete 2-3 Years*	*Complete Less Than Two Years*
H.S. Diploma	.51 (.01)	.21 (.01)	.28 (.01)
GED	.00 (†)	.10 (.04)	.90 (.04)

Panel C

Completion Rates For Two Year College Starters

	Transfer to a Four Year School and Graduate	*Complete 2-3 Years*	*Complete Less Than Two Years*
H.S. Diploma	.12 (.01)	.27 (.01)	.61 (.01)
GED	.01 (.01)	.15 (.04)	.84 (.03)

*Only 3.2% of the sample attended a two year college and then went on to a four year school.
"These are persons who start at four year colleges.
†Not Applicable; no GED recipients started four year colleges and completed them.
Note: The sample is defined for the subset of individuals who received their degree by 1983 and left school by 1987 - approximately 25% of the sample were dropped by these criteria.

Table 5

Schooling Transition Probabilities Thru High School Completion for NLSY Males
Logistic Probabilities (t-ratios in parentheses)

A. Combined Blacks, Hispanics, and Whites

Variable	*No School to Complete 9*	*Complete 9 to Attend HS*	*Attend HS to:* *HS Diploma*	*GED*
Intercept	2.736 (4.22)	2.710 (4.20)	1.471 (3.72)	0.932 (1.74)
Number of Siblings	-0.105 (3.29)	-0.162 (5.21)	-0.039 (1.75)	-0.037 (1.18)
Family Income	0.037 (4.63)	0.025 (3.71)	0.025 (6.06)	-0.002 (0.30)
Highest Grade Father	0.162 (5.43)	0.085 (2.90)	0.093 (4.63)	0.064 (2.36)
Highest Grade Mother	0.109 (3.12)	0.059 (1.71)	0.050 (2.14)	0.012 (0.39)
Broken Home	0.205 (0.94)	-0.609 (3.17)	-0.399 (3.13)	-0.278 (1.60)
Farm Age 14	-0.502 (1.68)	-0.347 (1.09)	0.230 (0.83)	-0.621 (1.46)
South Age 14	-1.064 (5.04)	-0.691 (3.53)	0.388 (3.11)	0.238 (1.41)
County Average Earnings	-0.132 (5.05)	-0.049 (1.84)	-0.087 (5.89)	-0.090 (4.31)
Black	0.991 (3.90)	0.995 (4.20)	-0.331 (2.22)	-0.413 (2.03)
Hispanic	0.688 (2.49)	0.576 (2.16)	-0.078 (0.45)	0.052 (0.22)
N	3965	3815		3660
-2 *Log-Likelihood:	1006.4	1141.9		4325.9

B. Blacks

Intercept	2.949 (2.60)	1.458 (1.32)	1.523 (2.32)	1.846 (1.86)
Number of Siblings	-0.085 (1.57)	-0.125 (2.48)	-0.026 (0.83)	-0.001 (0.03)
Family Income	0.030 (1.78)	-0.005 (0.34)	0.0024(3.06)	-0.006 (0.49)
Highest Grade Father	0.121 (2.18)	0.025 (0.43)	0.122 (3.54)	0.145 (2.82)
Highest Grade Mother	0.133 (1.93)	0.219 (3.44)	0.056 (1.38)	0.053 (0.89)
Broken Home	0.161 (0.46)	-1.041 (3.13)	-0.318 (1.67)	-0.784 (2.83)
Farm, Age 14	-0.465 (0.70)	0.083 (0.11)	0.283 (0.50)	-1.130 (0.99)
South, Age 14	-0.778 (2.02)	0.024 (0.07)	0.428 (2.40)	-0.277 (1.08)
County Average Earnings	-0.095 (2.33)	-0.024 (0.60)	-0.135 (5.22)	-0.227 (5.30)
N	1225	1181		1129
-2 *Log-Likelihood	339.6	385.1		1566.4

C. Hispanics

Variable	*No School to Complete 9*	*Complete 9 to Attend HS*	*Attend HS to:* *HS Diploma*	*GED*
Intercept	5.139 (4.54)	4.329 (3.67)	2.687 (3.65)	1.788 (1.81)
Number of Siblings	-0.106 (1.99)	-0.224 (4.02)	-0.030 (0.66)	-0.081 (1.32)
Family Income	0.038 (2.73)	0.037 (2.57)	0.033 (3.76)	-0.011 (0.88)
Highest Grade Father	0.151 (3.17)	0.118 (2.42)	0.032 (0.95)	0.042 (0.94)
Highest Grade Mother	0.067 (1.31)	-0.070 (1.35)	0.004 (0.11)	-0.019 (0.40)
Broken Home	0.513 (1.32)	0.005 (0.01)	-0.408 (1.60)	-0.059 (0.18)
Farm, Age 14	-1.405 (3.27)	0.080 (0.12)	-0.303 (0.59)	-0.719 (0.84)
South, Age 14	-1.100 (2.81)	-0.466 (1.11)	0.244 (0.87)	0.223 (0.61)
County Average Earnings	-0.203 (4.23)	-0.079 (1.53)	-0.127 (3.50)	-0.098 (2.00)
N	764	705		661
-2 *Log-Likelihood	317.4	285.8		970.7

D. Whites

Intercept	0.776 (0.54)	3.544 (2.84)	-1.055 (1.53)	-1.085 (1.23)
Number of Siblings	-0.121 (1.84)	-0.159 (2.72)	-0.094 (2.02)	-0.054 (0.88)
Family Income	0.035 (2.76)	0.029 (2.96)	0.020 (3.29)	0.003 (0.36)
Highest Grade Father	0.198 (3.47)	0.119 (2.31)	0.129 (3.34)	0.043 (0.89)
Highest Grade Mother	0.155 (2.18)	0.060 (0.93)	0.174 (3.65)	0.082 (1.35)
Broken Home	0.133 (0.30)	-0.540 (1.60)	-0.549 (2.22)	0.058 (0.19)
Farm, Age 14	1.638 (1.56)	-0.708 (1.65)	0.418 (1.00)	-0.230 (0.40)
South, Age 14	-1.250 (3.45)	-1.365 (4.47)	0.398 (1.62)	0.658 (2.20)
County Average Earnings	-0.056 (2.09)	-0.104 (1.92)	-0.022 (1.89)	-0.017 (1.56)
N	1976	1929		1870
-2 *Log-Liklihood	327.0	435.1		1703.7

Notes: County Average Earnings is defined at the county level for unskilled jobs. Family Income and County Average Earnings are denominated in 1000's of 1990 dollars. See the Appendix for further definitions of the variables.

Table 5E

Logistic Transition from Attend High School To
Obtain High School Credentials (High School Completion and GED Combined)
(T-ratios in Parentheses)

Variables	*Combined Black Hispanics and White Samples*	*Black Sample*	*Hispanic Sample*	*White Sample*
Intercept	1.80 (4.61)	1.91 (3.0)	2.98 (4.2)	-.66 (0.98)
Number Siblings	-.040 (1.76)	-.023 (0.73)	-.040 (0.89)	-.087 (1.90)
Family Income	.022 (5.45)	.021 (2.7)	.027 (3.2)	.020 (3.1)
Highest Grade Father	.089 (4.49)	.125 (3.7)	.033 (1.0)	.120 (3.1)
Highest Grade Mother	.042 (1.90)	.055 (1.4)	.001 (.10)	.157 (3.4)
Broken Home	-.38 (3.00)	-.374 (2.0)	-.331 (1.3)	-.450 (1.8)
Farm Age 14	.136 (0.50)	.177 (0.32)	-.371 (0.73)	.348 (0.8)
South Age 14	.367 (2.99)	.344 (2.0)	.240 (0.87)	.44 (1.8)
County Average Earnings	-.088 (6.00)	-.145 (5.6)	-.122 (3.4)	-.021 (1.0)
Black	-.344 (2.31)	-na-	-na-	-na-
Hispanic	-.056 (0.32)	-na-	-na-	-na-

na = Not Applicable

Table 6
Simulation Results For Secondary School Transitions: Changes in Probabilities
Of Attaining The Grade Level Indicated At The Head Of The Table
Compare Tables 5A-5D
(Carry-Over Effects As A Percent of Total Effects" in Parentheses)

	Complete 9	*Attend High School*	*Obtain GED*	*Graduate High School*
A. 33% Increase in Family Income				
Combined	.008 (na)	.013 (46%)	-.012 (-2%)	.039 (24%)
Black	.006 (na)	.004 (141%)	-.010 (-6%)	.032 (10%)
Hispanic	.014 (na)	.024 (47%)	-.018 (-25%)	.062 (26%)
White	.005 (na)	.011 (36%)	-.009 (-4%)	.028 (27%)
B. 33% Decrease in the Number of Siblings				
Combined	.006 (na)	.014 (31%)	.002 (66%)	.014 (58%)
Black	.006 (na)	.014 (40%)	-.001 (40%)	.016 (48%)
Hispanic	.012 (na)	.030 (33%)	.011 (25%)	.018 (124%)
White	.003 (na)	.008 (28%)	-.001 (12%)	.012 (33%)
C. 33% Decrease in County Average Earnings				
Combined	.021 (na)	.029 (56%)	.011 (24%)	.054 (33%)
Black	.017 (na)	.009 (424%)	.055 (2%)	.048 (21%)
Hispanic	.054 (na)	.070 (61%)	.008 (103%)	.128 (33%)
White	.006 (na)	.018 (24%)	.002 (-326%)	.020 (55%)
D. 33% Increase in the Highest Grade Completed of the Father				
Combined	.010 (na)	.016 (50%)	-.002 (48%)	.037 (31%)
Black	.008 (na)	.010 (73%)	.010 (10%)	.039 (22%)
Hispanic	.012 (na)	.021 (50%)	.007 (38%)	.019 (64%)
White	.008 (na)	.016 (41%)	-.013 (10%)	.047 (23%)
E. 33% Increase in the Highest Grade Completed of the Mother				
Combined	.008 (na)	.013 (50%)	-.006 (9%)	.029 (31%)
Black	.012 (na)	.032 (36%)	.004 (64%)	.044 (48%)
Hispanic	.007 (na)	-.003 (-118%)	-.005 (-28%)	.003 (157%)
White	.008 (na)	.012 (50%)	-.014 (-54%)	.051 (16%)

na = not applicable: no carry-over effect for the initial state.

note continued on next page

*Carry-over effects are expressed as a percentage of the total effects. A negative percentage means the carry-over and total effects are of opposite sign. A percentage greater than 100 means the carry-over effect is larger than the total effect.

Carry over effects are defined in the following way: if i is the origin state and j is the destination state, P_{ij} is the probability of making the transition. Let "0" denote the base state. The probability of attaining state ℓ is

$$P_\ell = P_0\left[\sum_{w=1}^{W}\prod_{s=1}^{l_w} P_{w(s),w(s+1)}\right]$$

where l_w = the number of steps in path w starting from 0 and ending in ℓ, and s is the step in the path associated with state w(s) and W is the number of paths that start from "0" and end at ℓ. A path is indexed by w(s), w(s+1),...,etc., the transitions that define it (the same intermediate state may appear in several paths). Let "~" denote the new value of the associated probability that results from changing conditioning values of the covariates.

The total change in the probability is $\tilde{P}_\ell - P_\ell$. The carry-over effect for destination ℓ as a percent of the total effect is defined to be

$$100 \times \left[\sum_{w=1}^{W}\left[\tilde{P}_0\left(\prod_{s=1}^{l_{w-1}}\tilde{P}_{w(s),w(s+1)}\right) - P_0\left(\prod_{s=1}^{l_{w-1}} P_{w(s),w(s+1)}\right)\right] P_{w(l_{w-1}),\ell}\right] / \left[\tilde{P}_\ell - P_\ell\right].$$

Table 7

Post-Secondary School Transitions for NLSY Males
Logistic Transition Probabilities (t-ratios in parentheses)

A. Combined Blacks, Hispanics, and Whites

Variable	*HS Diploma to Attend College*	*GED to Attend College*	*Attend College to Complete 4 years*	*Complete 4 years to Attend 5 years+*
Intercept	-2.463 (7.79)	-4.380 (2.86)	-0.778 (1.85)	-1.766 (2.86)
Number of Siblings	-0.090 (4.80)	-0.004 (0.05)	-0.051 (1.80)	-0.069 (1.71)
Family Income	0.012 (5.27)	-0.014 (1.25)	0.009 (3.10)	0.002 (0.49)
Highest Grade Father	0.109 (6.98)	0.189 (2.65)	0.065 (2.95)	0.033 (1.24)
Highest Grade Mother	0.119 (6.05)	0.056 (0.77)	0.074 (2.73)	0.080 (2.29)
Broken Home	0.020 (0.18)	0.853 (2.26)	-0.271 (1.68)	-0.190 (0.84)
Farm, Age 14	-0.034 (0.19)	0.000 (0.00)	0.177 (0.60)	0.191 (0.52)
South, Age 14	-0.113 (1.17)	0.045 (0.11)	0.071 (0.53)	-0.401 (2.31)
County Average Earnings	-0.017 (2.66)	0.011 (0.41)	-0.022 (1.54)	-0.009 (0.49)
Black	0.305 (2.73)	-1.502 (3.03)	-0.123 (0.75)	0.098 (0.47)
Hispanic	0.797 (6.00)	0.118 (0.25)	-0.014 (0.07)	0.233 (0.95)
N	2915	336	1768	859
-2 *Log-Likelihood	3622.6	232.7	1655.8	1065.8

B. Blacks

Intercept	-2.266 (3.58)	-9.960 (2.39)	-1.281 (1.47)	-3.172 (2.15)
Number of Siblings	-0.095 (3.18)	0.131 (0.65)	-0.072 (1.61)	0.146 (2.01)
Family Income	0.008 (1.43)	0.013 (0.67)	0.004 (0.51)	0.006 (0.56)
Highest Grade Father	0.020 (0.61)	0.066 (0.26)	0.074 (1.61)	0.135 (1.92)
Highest Grade Mother	0.220 (5.31)	0.129 (0.55)	0.064 (1.16)	0.071 (0.84)
Broken Home	-0.010 (0.06)	1.465 (1.51)	-0.404 (1.52)	-0.191 (0.45)
Farm, Age 14	-0.882 (1.71)	0.000 (0.00)	0.269 (0.29)	2.037 (1.61)
South, Age 14	-0.195 (1.14)	-1.264 (0.95)	0.115 (0.48)	-0.342 (0.91)
County Average Earnings	-0.013 (1.13)	-0.107 (0.79)	-0.022 (0.77)	-0.033 (0.86)
N	835	114	446	184
-2 *Log-Likelihood	1033.6	41.2	446.2	205.2

C. Hispanics

Variable	*HS Diploma to Attend College*	*GED to Attend College*	*Attend College to Complete 4 years*	*Complete 4 years to Attend 5 years+*
Intercept	0.292 (0.40)	-1.366 (0.76)	-0.426 (0.52)	-3.621 (2.16)
Number of Siblings	-0.061 (1.55)	0.025 (0.18)	-0.024 (0.39)	0.012 (0.13)
Family Income	0.009 (1.46)	-0.009 (0.34)	0.022 (2.20)	0.017 (1.25)
Highest Grade Father	0.018 (0.62)	0.164 (1.61)	-0.026 (0.59)	0.052 (0.70)
Highest Grade Mother	0.081 (2.48)	-0.005 (0.05)	0.055 (1.16)	0.022 (0.28)
Broken Home	-0.325 (1.27)	0.196 (0.27)	-0.624 (1.62)	-0.127 (0.18)
Farm, Age 14	0.319 (0.63)	0.000 (0.00)	0.816 (0.92)	2.166 (1.60)
South, Age 14	-0.440 (1.72)	0.061 (0.08)	0.503 (1.43)	-1.151 (1.92)
County Average Earnings	-0.038 (1.86)	-0.059 (1.35)	-0.015 (0.38)	0.072 (1.21)
N	473	82	292	111
-2 *Log-Likelihood	614.3	65.8	280.7	124.6

D. Whites

Intercept	-4.284 (8.53)	-5.013 (1.91)	-1.907 (2.92)	-1.344 (1.61)
Number of Siblings	-0.150 (4.58)	-0.131 (0.88)	-0.094 (1.87)	-0.275 (4.02)
Family Income	0.013 (4.27)	-0.003 (2.11)	0.008 (2.26)	0.002 (0.45)
Highest Grade Father	0.220 (9.02)	0.280 (2.37)	0.107 (3.32)	0.024 (0.72)
Highest Grade Mother	0.158 (4.59)	0.073 (0.65)	0.168 (3.54)	0.127 (2.68)
Broken Home	0.272 (1.44)	1.209 (2.19)	0.039 (0.15)	-0.242 (0.75)
Farm, Age 14	0.107 (0.48)	0.000 (0.00)	0.101 (0.30)	-0.119 (0.28)
South, Age 14	0.087 (0.62)	0.484 (0.80)	-0.107 (0.55)	-0.390 (1.73)
County Average Earnings	-0.016 (1.86)	0.014 (0.30)	-0.054 (2.45)	-0.029 (1.18)
N	1607	136	1030	564
-2 *Log-Likelihood	1874.6	107.9	894.7	698.2

Notes: County Average Earnings is defined at the county level for unskilled jobs. Family Income and County Average Earnings are denominated in 1000's of 1990 dollars. See the Appendix for further definitions of the variables.

Table 8

Simulation Results For College Transitions, Changes in Average Probabilities
Of Attaining The Grade Level Indicated At The Head Of The Table
Compare Tables 7A-7D
(Carry-Over Effects As a Percent of the Total Effect in Parentheses, see definition at base of Table 6)

	Grad. HS to Attend College	*GED to Attend College*	*Attend College to Complete 4*†	*Complete 4 years to Attend 5+*
A. 33% Increase in Family Income				
Combined	.041 (51%)	-.002 (47%)	.038 (76%)	.014 (93%)
Black	.024 (63%)	-.000 (456%)	.017 (87%)	.008 (77%)
Hispanic	.047 (76%)	-.006 (71%)	.046 (66%)	.023 (70%)
White	.042 (37%)	-.003 (23%)	.041 (73%)	.016 (89%)
B. 33% Decrease in the Number of Siblings				
Combined	.021 (21%)	.000 (58%)	.016 (73%)	.008 (62%)
Black	.025 (22%)	-.000 (5%)	.020 (69%)	-.001 (-211%)
Hispanic	.020 (33%)	.002 (135%)	.013 (77%)	.002 (123%)
White	.027 (17%)	.001 (27%)	.024 (70%)	.024 (42%)
C. 33% Decrease in County Average Earnings				
Combined	.036 (57%)	.000 (66%)	.033 (68%)	.013 (82%)
Black	.027 (8%)	.000 (987%)	.005 (592%)	.007 (7%)
Hispanic	.100 (67%)	.008 (46%)	.059 (88%)	.002 (-424%)
White	.023 (35%)	-.000 (-39%)	.041 (39%)	.027 (61%)
D. 33% Increase in the Highest Grade Completed of the Father				
Combined	.079 (27%)	.006 (-12%)	.073 (75%)	.033 (81%)
Black	.026 (63%)	.000 (45%)	.032 (53%)	.031 (47%)
Hispanic	.017 (57%)	.011 (21%)	.003 (125%)	.007 (24%)
White	.154 (20%)	.005 (-59%)	.147 (76%)	.060 (89%)
E. 33% Increase in the Highest Grade Completed of the Mother				
Combined	.081 (21%)	.001 (-257%)	.077 (73%)	.049 (67%)
Black	.133 (20%)	.000 (16%)	.098 (85%)	.044 (80%)
Hispanic	.030 (6%)	-.002 (80%)	.030 (59%)	.011 (78%)
White	.122 (24%)	-.001 (745%)	.144 (65%)	.106 (67%)

†For high school graduates only. The comparable transition for GED recipients is not studied due to the small number who complete 4 years (see text for more discussion).

Table 9

Transitions From High School Graduation or GED to 2- and 4- Year Colleges, Vocational-Technical School, Company Training-Apprenticeship, Military Service, and Work
Logistic Transition Probabilities (t-ratios in parentheses)

A. Combined Blacks, Hispanics, and Whites

Variable	*Attend a 4yr College*	*Attend a 2 yr College*	*Vocational-Tech School*	*Company Train-Apprentice*	*Military*	*Work*
Intercept	-2.531 (3.78)	-1.174 (1.75)	0.225 (0.30)	-2.435 (2.57)	0.587 (0.73)	0.541 (0.82)
Number of Siblings	-0.129 (3.57)	-0.098 (2.71)	-0.099 (2.35)	-0.110 (1.89)	-0.067 (1.52)	-0.022 (0.64)
Family Income	0.023 (3.57)	0.013 (2.00)	0.007 (0.99)	0.025 (3.12)	-0.025 (2.96)	0.015 (2.39)
Highest Grade Father	0.147 (4.45)	0.102 (3.07)	0.035 (0.94)	0.050 (1.04)	0.071 (1.75)	-0.001 (0.04)
Highest Grade Mother	0.191 (4.77)	0.127 (3.20)	0.079 (1.75)	0.027 (0.47)	0.063 (1.28)	0.023 (0.59)
Broken Home	0.152 (0.66)	0.344 (1.49)	0.500 (1.92)	0.373 (1.07)	-0.251 (0.89)	0.294 (1.27)
Farm Age 14	0.197 (0.48)	0.099 (0.24)	0.218 (0.48)	-.176 (0.67)	-0.604 (1.08)	0.305 (0.75)
South Age 14	-0.045 (0.23)	-0.301 (1.51)	-0.176 (0.77)	-0.549 (1.80)	-0.076 (0.32)	-0.013 (0.06)
County Average Earnings	0.019 (0.73)	0.017 (0.63)	-0.041 (1.29)	0.072 (2.22)	-0.035 (1.05)	0.029 (1.19)
Black	-0.043 (0.18)	-0.317 (1.29)	-0.563 (1.98)	-0.581 (1.59)	-0.458 (1.56)	-0.454 (1.85)
Hispanic	0.796 (2.52)	0.911 (2.89)	0.492 (1.40)	-0.054 (0.12)	0.028 (0.07)	-0.247 (0.76)
GED	-1.070 (3.51)	-0.541(2.01)	0.255 (1.20)	0.200 (0.62)	-0.060 (0.18)	0.157 (0.56)
N	1110	772	269	106	198	644
-2 *Log-Likelihood:	9656.02					

B. Black Sample

Intercept	-0.936 (0.84)	-1.396 (1.20)	1.321 (0.96)	-4.354 (2.21)	1.178 (0.86)	0.875 (0.79)
Number of Siblings	-0.186 (3.65)	-0.107 (2.05)	-0.141 (2.21)	-0.224 (2.07)	-0.105 (1.69)	-0.073 (1.46)
Family Income	0.017 (1.93)	0.005 (0.40)	-0.004 (0.24)	0.025 (1.59)	-0.023 (1.48)	0.014 (1.22)
Highest Grade Father	0.029 (0.51)	-0.017 (0.30)	0.017 (0.24)	-0.060 (0.59)	0.054 (0.76)	-0.047 (0.84)
Highest Grade Mother	0.147 (2.16)	0.191 (2.70)	0.037 (0.44)	0.085 (0.68)	0.022 (0.27)	-0.044 (0.66)
Broken Home	0.289 (0.91)	0.645 (1.97)	0.317 (0.81)	0.976 (1.71)	-0.003 (0.01)	0.541 (1.69)
Farm Age 14	-0.739 (0.93)	-0.407 (0.51)	-0.103 (0.12)	-0.039 (0.11)	-0.094 (0.14)	0.093 (0.13)
South Age 14	-0.109 (0.38)	-0.335 (1.13)	-0.055 (0.15)	-1.602 (2.67)	-0.145 (0.41)	0.217 (0.73)
GED	-1.975 (4.01)	-1.201 (2.61)	0.245 (0.91)	0.405 (0.65)	-0.830 (1.58)	-0.159 (0.46)
County Average Earnings	0.049 (1.01)	0.049 (0.99)	-0.081 (1.30)	0.209 (3.02)	-0.056 (0.92)	0.053 (1.27)
N	288	195	72	22	75	212
-2 *Log-Likelihood	2876.93					

C. Hispanics

Variable	*Attend a 4yr College*	*Attend a 2 yr College*	*Vocational-Tech School*	*Company Train-Apprentice*	*Military*	*Work*
Intercept	-3.926 (2.58)	-1.758 (1.19)	-1.887 (1.18)	-5.407 (2.35)	-2.534 (1.33)	-3.374 (2.21)
Number of Siblings	0.043 (0.53)	-0.086 (1.06)	0.018 (0.21)	0.066 (0.52)	0.083 (0.84)	0.044 (0.55)
Family Income	0.033 (2.15)	0.019 (1.12)	0.020 (1.06)	0.028 (1.24)	-0.019 (1.13)	0.026 (1.49)
Highest Grade Father	0.084 (1.38)	0.048 (0.81)	0.034 (0.52)	0.132 (1.34)	0.057 (0.75)	0.027 (0.44)
Highest Grade Mother	0.163 (2.37)	0.089 (1.33)	0.083 (1.12)	0.025 (0.23)	0.114 (1.33)	0.047 (0.69)
Broken Home	0.015 (0.03)	-0.346 (0.69)	1.026 (1.92)	-0.612 (0.67)	-0.989 (1.39)	0.090 (0.18)
Farm Age 14	0.213 (0.26)	-1.248 (1.27)	-0.055 (0.06)	-0.045 (0.13)	-0.245 (0.45)	-0.260 (0.32)
South Age 14	0.127 (0.27)	-0.218 (0.46)	-0.092 (0.17)	-1.632 (1.44)	0.029 (0.05)	0.405 (0.85)
County Average Earnings	0.147 (1.82)	0.154 (1.94)	0.053 (0.61)	0.179 (1.51)	0.100 (1.20)	0.195 (2.39)
GED	-1.070 (2.01)	-0.731(1.31)	0.305 (0.95)	1.000 (1.22)	0.540 (0.88)	0.652 (1.26)
N	152	163	59	16	33	105
-2 *Log-Likelihood:	1668.05					

D. Whites

Intercept	-4.988 (4.47)	-3.266 (2.91)	-0.970 (0.78)	-2.285 (1.64)	0.164 (0.12)	0.470 (0.44)
Number of Siblings	-0.206 (2.80)	-0.106 (1.44)	-0.136 (1.63)	-0.079 (0.83)	-0.100 (1.13)	0.009 (0.12)
Family Income	0.020 (2.24)	0.012 (1.34)	0.006 (0.60)	0.024 (2.33)	-0.027 (2.35)	0.013 (1.46)
Highest Grade Father	0.280 (4.78)	0.242 (4.08)	0.087 (1.34)	0.103 (1.41)	0.114 (1.63)	0.022 (0.38)
Highest Grade Father	0.320 (4.20)	0.204 (2.67)	0.142 (1.67)	0.032 (0.34)	0.086 (0.95)	0.056 (0.76)
Broken Home	-0.019 (0.04)	0.357 (0.78)	0.068 (0.13)	0.172 (0.29)	-0.272 (0.51)	0.019 (0.04)
Farm Age 14	0.857 (1.12)	0.921 (1.21)	0.824 (1.03)	-0.705 (0.57)	0.293 (0.34)	0.875 (1.15)
South Age 14	0.059 (0.17)	-0.107 (0.31)	-0.230 (0.59)	0.160 (0.37)	0.064 (0.16)	-0.226 (0.65)
County Average Earnings	-0.017 (0.13)	-0.040 (0.30)	-0.118 (0.78)	0.054 (0.32)	-0.171 (1.48)	0.060 (0.77)
GED	-0.820 (2.51)	-0.535(2.01)	0.895 (1.25)	0.942 (1.32)	0.640 (1.08)	0.852 (1.45)
N	670	414	138	68	90	327
-2 *Log-Likelihood:	4927.36					

Notes: "Not Work" is the left-out state. County Average Earnings is defined at the county level for skilled jobs. Family Income and County Average Earnings are denominated in 1000's of 1990 dollars. See the Appendix for further definitions of the variables.

Table 10

Simulation Results for College, Training, Military and Work
Changes In Average Probabilities Of Attaining The Grade Level Indicated At The Head
Of The Column in The Table (Carry-Over Effects As a Percent of the Total Effects in Parentheses)

A. 33% Increase in Family Income

	Attend 4-Year College	*Attend a 2-Year College*	*Voc-Tech School*	*Company Training/Appren.*	*Military*	*Work*	*No Work*
Combined	.030 (37%)	.000 (96%)	-.003 (-318%)	.005 (20%)	-.010 (-20%)	.009 (41%)	-.003 (191%)
Black	.019 (50%)	-.002 (373%)	-.003 (79%)	.005 (7%)	-.008 (-22%)	.012 (29%)	-.002 (-639%)
Hispanic	.031 (54%)	.002 (131%)	.002 (140%)	.002 (6%)	-.007 (-72%)	.015 (35%)	-.003 (10%)
White	.029 (29%)	-.004 (-250%)	-.004 (39%)	.007 (8%)	-.011 (-2%)	.006 (35%)	-.003 (129%)

B. 33% Decrease in the Number of Siblings

Combined	.014 (23%)	.006 (-3%)	.003 (65%)	.001 (36%)	.001 (49%)	-.007 (-37%)	-.003 (-40%)
Black	.022 (20%)	.000 (-66%)	.003 (46%)	.004 (14%)	.000 (101%)	-.006 (-565%)	-.009 (-11%)
Hispanic	-.003 (320%)	.032 (20%)	.002 (264%)	-.001 (-54%)	-.002 (-75%)	-.001 (-35%)	.002 (101%)
White	.022 (14%)	.001 (-589%)	.003 (030%)	-.000 (392%)	.001 (44%)	-.016 (-55%)	-.001 (-4%)

C. 33% Decrease in County Average Earnings

Combined	.006 (138%)	.009 (254%)	.029 (25%)	-.007 (2%)	.018 (26%)	-.001 (-27%)	.008 (51%)
Black	.006 (44%)	.006 (115%)	.047 (39%)	-.017 (-18%)	.037 (23%)	-.006 (11%)	.018 (68%)
Hispanic	.019 (76%)	.015 (90%)	.058 (34%)	-.001 (36%)	.018 (52%)	-.021 (-57%)	.049 (27%)
White	.003 (217%)	.010 (36%)	.012 (15%)	-.002 (44%)	.012 (11%)	-.014 (-16%)	.001 (233%)

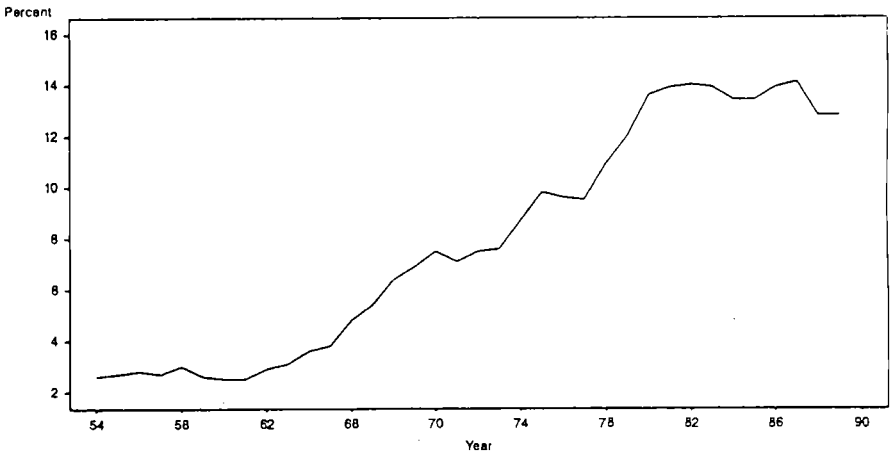
D. 33% Increase in the Highest Grade Completed of the Father

Combined	.067 (22%)	.014 (-14%)	-.007 (-91%)	-.003 (75%)	-.001 (39%)	-.032 (42%)	-.006 (-71%)
Black	.037 (38%)	.002 (1387%)	.005 (75%)	-.003 (124%)	.012 (32%)	-.010 (273%)	.004 (90%)
Hispanic	.023 (35%)	.002 (120%)	-.001 (1640%)	.007 (37%)	.002 (91%)	-.005 (13%)	-.002 (-73%)
White	.108 (14%)	.042 (13%)	-.016 (94%)	-.007 (-1221%)	-.005 (-14%)	-.077 (-28%)	-.009 (31%)

E. 33% Increase in the Highest Grade Completed of the Mother

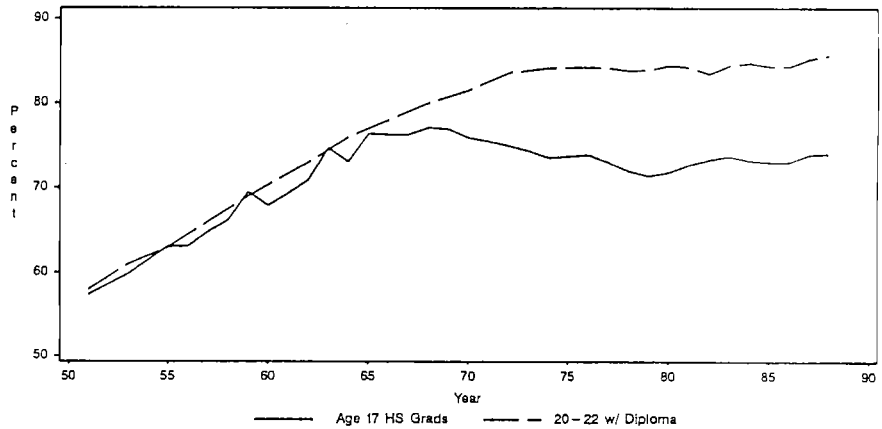
Combined	.080 (14%)	.008 (20%)	-.005 (20%)	-.008 (-8%)	-.005 (-212%)	-.038 (-71%)	-.009 (2053%)
Black	.051 (25%)	.071 (20%)	-.005 (33%)	-.001 (80%)	-.007 (-301%)	-.051 (-1%)	-.010 (-208%)
Hispanic	.035 (6%)	-.008 (26%)	-.003 (14%)	-.004 (13%)	.001 (8%)	-.018 (14%)	-.005 (5%)
White	.148 (12%)	-.002 (20%)	-.008 (9%)	-.014 (-2%)	-.010 (264%)	-.068 (-2%)	-.010 (-4%)

Figure 1: New GED Recipients as a Percentage of Total New Recipients of High School Credentials (GED + High School Graduates)



Source: Digest of Education Statistics 1989, U.S. Department of Education. The GED Statistical Report, American Council on Education. Current Population Reports, Series P-20 (selected years), U.S. Department of Commerce, Bureau of the Census

Figure 2: The Percentage of 17 Year Olds who are High School Graduates*
and the Percentage of 20–24 Year Olds with at Least a High School Diploma



*Note: Includes graduates of regular day school programs. Excludes graduates of other programs, when separately reported, and high school equivalency recipients.

Source: U.S. Department of Education, National Center for Education Statistics, Digest of Education Statisctics 1989; U.S. Departetment of Commerce, Bureau of the Census, Current Population Reports, Series P–20 (selected years)