

Who Benefits from a GED?
Evidence for Females from *High School and Beyond*

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Abstract

This paper examines the labor market value of the GED for females, questioning two implicit assumptions that have been employed in earlier studies. We show that providing access to work experience may be a critical mechanism through which education credentials impart labor market value and that the labor market value of the GED credential depends on the skills with which dropouts left school. Our basic finding is that among females who dropped out of high school with weak basic math skills, those with a GED have accumulated more work experience and have higher labor market earnings in their mid-20s than are observationally similar dropouts lacking the GED credential.

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Changes in the American economy over the last 30 years have been extremely unfavorable for workers with little formal education, especially school dropouts. While considerable attention has focused on the plight of male dropouts (cf., Burtless (1990); Cameron & Heckman (1993)), there has been much less attention devoted to earnings prospects for female dropouts. Yet they too have experienced declining labor market opportunities. Between 1979 and 1996, the real wages of 25-34 year old female dropouts fell by 22 percent, from \$8.12 to \$6.36 per hour.¹

The primary second chance opportunity for school dropouts to acquire a school-leaving credential is the General Educational Development (GED) credential. In 1998 more than half a million school dropouts obtained a GED, about half of whom were women. While neither the U.S. Census nor the Current Population Survey distinguished GED recipients from conventional high school graduates prior to 1998,² employers apparently did. A number of recent papers show that male GED recipients do not fare as well in the labor market, on average, as observationally similar conventional high school graduates. Recent papers have also made a different set of comparisons, examining whether receipt of a GED improves labor market prospects for male dropouts. They show that male dropouts who leave school with weak cognitive skills do benefit from acquiring a GED. However, this is not the case for males who drop out of school with stronger skills.

The convergence of evidence on the labor market benefits of the GED credential for male dropouts raises the question of whether the same patterns hold for female dropouts. To date,

¹ Authors' tabulation of Current Population Survey (CPS) data.

² The Current Population Survey began distinguishing GED holders in the January 1998 public use files.

however, there has been little research on this question. Cao, Stromsdorfer, and Weeks (1996) reported no difference in average annual hours of work between uncredentialed dropouts and GED holders who have the same number of years of completed schooling. They also found no difference between the hourly wages of uncredentialed dropouts and those of GED holders once they controlled for years of completed schooling. Thus, their work, using both *National Longitudinal Survey of Youth* (NLSY) and Washington state data, suggests that after controlling for important observable factors, there is little gain associated with acquiring a GED.

Two important constraints embodied in the specifications used by Cao, Stromsdorfer, and Weeks suggest that another look at the labor market outcomes for females with different educational credentials is warranted. First, all of their specifications control for work experience. Opening the door to work opportunities may be one way the GED benefits dropouts, and thus it may be inappropriate to control for work experience when estimating the total effect of the GED on earnings or wages. For comparability with Cao, Stromsdorfer, and Weeks, we will present results from specifications that control for work experience. However, our primary results will come from specifications that allow the GED to affect earnings through increased work experience.³

Second, an implicit assumption in the Cao, Stromsdorfer, and Weeks paper is that the labor market value of the GED does not depend on the skills with which dropouts left school. Two recent papers show that this assumption does not hold for males. Using *High School and Beyond* (HSB) data, Murnane, Willett, and Tyler (2000) find large GED effects on the annual earnings of males who left school with low cognitive skills and no effects for males who left with higher

³ Cao et al.'s paper does include a brief section in which the authors' state that excluding work experience from their model does not alter their basic result so long as years of completed schooling is also included as a control variable. They also report fitting a model that did not include work experience or years of completed schooling and found that

cognitive skills. Meanwhile, employing a quasi-experimental design and a specially constructed data set, Tyler, Murnane, and Willett (2000) find similar results in data that include both males and females. Their results show that young white GED holders (both male and female) with skills that place them on the margin of being able to pass the GED exams have annual earnings 10 to 19 percent higher than the comparison group with similar skills. These two papers suggest the potential value of exploring in HSB data whether the labor market value of the GED credential depends on the skills with which females left high school.

Our results show the following patterns. First, we replicate the Cao et al. finding that, after controlling for work experience, female GED recipients do not, on average, earn more than do observationally similar female dropouts without a GED. Second, female GED recipients do acquire more work experience than do uncredentialed female dropouts and this work experience does lead to higher earnings. Third, labor market benefits associated with the GED accrue only to female dropouts who left school with relatively low cognitive skills, as measured by a basic math test that requires not only a knowledge of basic math, but also the ability to read and follow directions. At the end of this paper, we explain these results by arguing that the GED has signaling value for female dropouts who left school with weak cognitive skills.

I. The GED

The GED was introduced in 1942 to provide a way for veterans without a high school diploma to earn a secondary school credential and become eligible for the G.I. Bill college benefits. The GED program has evolved markedly since its modest inception. In 1998, 796,000 dropouts attempted the GED exams and half a million were awarded the certificate.

in this model GED recipients had higher wages than uncredentialed dropouts (Cao, Stromsdorfer & Weeks 1996, p. 217).

To obtain a GED dropouts have to pass a seven and one-half hour, five test battery of examinations that covers mathematics, writing, reading, social studies, and science. The GED Testing Service (GEDTS) and the individual state departments of education jointly administer the GED program. The GEDTS establishes a minimum passing level, but many states have chosen a higher passing standard.

Each year thousands of individuals enroll in GED preparation programs supported by federal and state tax proceeds. A premise underlying these investments is that acquisition of the GED imparts benefits to recipients. This paper examines the validity of this premise by exploring whether acquisition of a GED imparts one important class of benefits to female dropouts, namely, improved labor market outcomes.

There are several reasons that GED holders might fare better in the labor market than observationally similar dropouts without the credential. First, for dropouts with low levels of basic cognitive skills or with English language deficiencies, preparing for the GED exams may increase their cognitive skills. Since the median number of hours dropouts report studying for the GED exams is only 30 (Baldwin 1992), acquiring human capital is probably not a mechanism through which the GED improves labor market outcomes for most dropouts. However, there is a long right-hand tail to the distribution of study times. Consequently, a minority of dropouts who left school with very low cognitive skills may markedly increase their human capital in the many months that they spend studying for the GED exams.

A second reason the GED may be associated with improved labor market outcomes is that its acquisition may improve access to post-secondary education. As many studies report, college credentials have become increasingly important in the last 20 years (Gottschalk 1997).

The GED credential may also benefit dropouts by signaling to employers that the recipient is a better job candidate than employers would have judged in the absence of the credential (Spence 1973). The work of Tyler, Murnane, and Willett (2000) supports this signaling role of the GED.

Of course, another possibility is that estimated earnings differences between GED holders and observationally similar dropouts without the credential simply reflect selection bias. We return to this possibility at the end of the paper.

II. The High School and Beyond Data Base

In 1980, the U.S. Department of Education collected information on a stratified random sample of 14,825 sophomores in the nation's high schools. Follow-up surveys were conducted in 1982, 1984, 1986, and 1992. Based on questions in these follow-up surveys, it is possible to distinguish GED holders from uncredentialed dropouts in the HSB data.

A particular strength of the HSB data is the availability of scores on a series of tests of basic cognitive skills administered in the base year of the survey. These scores provide information on skills that would be rewarded in the labor market irrespective of education credentials (Neal & Johnson 1996). These scores also allow us to explore whether, as is the case for males, the labor market benefits to the GED for female dropouts who left school with low cognitive skills are greater than the benefits to those who left school with stronger cognitive skills. A second strength is the detailed, transcript-based information on post-secondary education. This allows us to examine the extent to which improved access to post-secondary schooling is an important mechanism through which the GED improves labor market outcomes for female dropouts.

A limitation of the HSB data is that labor market outcomes are restricted to annual earnings. Unlike the data that Cao et al. used, the HSB data does not include information on either hours of work or hourly wages. A second limitation is that the baseline survey was administered to a sample of students who were in the tenth grade. Consequently, females who had dropped out prior to the tenth grade are omitted from the sampled population.

Our analytic sample is composed of 4,785 females who took the mathematics test in 1980, participated in the 1992 survey, had non-missing earnings records for either 1990 or 1991, were not in the military in 1992, and were not in college in both 1990 and 1991. In an effort to reduce sample selection bias, we do include individuals who had zero earnings in both 1990 and 1991 in the samples used in predicting annual earnings and the probability of employment.⁴

The dependent variable in our earnings models is the average of 1990 and 1991 earnings. For individuals who were in college in one of those years or who had missing earnings records for one of the years, we use their earnings figure for the other year. We defined the dependent variable in this manner for two reasons. First, for individuals who reported their earnings for both years, the two-year average is a better measure of permanent income than is a single year's reported income. Second, using earnings for one year for those individuals who were in college the other year or who had missing earnings for the other year allows us to include 585 women who would otherwise have been omitted from the sample. Again, this decision reduces sample selection bias. Our regression models include dichotomous indicators identifying individuals who had valid earnings figures for one of the two years, but not both.

Forty-seven percent of the school dropouts in our sample had obtained a GED by 1990. This is higher than the 37 percent of female dropouts in the NLSY who had obtained a GED (Boudett 2000). The most plausible explanation for this difference lies in the fact that no one who dropped

out before the tenth grade is included in the HSB sample, while the NLSY sample includes individuals who dropped out in earlier grades. Murnane, Willett, and Tyler, (2000) showed that a lower percentage of males who dropped out before the tenth grade obtained a GED than did males who dropped out after starting grade 10.

In our sample, 11 percent of the females who entered the tenth grade eventually dropped out of school. Table 1 presents the descriptive statistics for the analytic sample, and as that table shows regular high school graduates fare better on most measures than GED holders, who in turn fare better than uncredentialed dropouts. In particular, the math scores of the individuals who dropped out are considerably lower than the scores of the females who eventually graduated from high school. Thus, one reason these females may have dropped out is poor academic performance. For many females, however, dropping out may have been related to having a child while in school. A check of the data shows that four percent of the high school graduates had children in or before their graduation year of 1982. The comparable figure for dropouts is 40 percent.

Child bearing decisions, while an important consideration in any study of the labor market outcomes of females, are certainly not exogenous. This common problem in empirical work has been addressed in several studies including Nakamura and Nakamura (1994), Korenman and Neumark (1992), and Angrist and Evans (1998). In our sample the average number of children in the home in the years we measured earnings was 2.1 for uncredentialed dropouts, 1.8 for GED holders, and 0.8 for conventional high school graduates. Also, at age 27, a higher percentage (52.9) of uncredentialed dropouts had a child under five in the home than did females in the other education groups (46.2 percent for GED holders and 36.7 percent for high school graduates). While we would like to account for the endogeneity of childbearing decisions in our analysis, we

⁴ Sample selection criteria for our analytic data set are described in the Data Appendix.

do not have a suitable instrument in our data. As a result, we have chosen instead to present results that do and do not control for fertility decisions. Our substantive results are consistent across these models.

A notable characteristic of the female GED recipients in our sample is the high percentage who obtained their GED soon after leaving high school. Forty five percent of all GED holders obtained the credential either before the graduation date of their school cohort or within 6 months of the graduation date. Dropouts who left school with relatively strong basic cognitive skills as measured by scores on the math test were both more likely to obtain a GED than dropouts with weaker skills, and were more likely to obtain the credential quickly.⁵

Table 2 shows that 34 percent of the GED holders in the sample obtained at least one post-secondary credit by 1990, compared to only 6 percent of the uncredentialed dropouts. However, only eleven percent of the GED holders in the sample completed at least two years of college credits. The overall message of Table 2 is that while GED holders obtain more post-secondary education than uncredentialed dropouts, the cumulative amount of post-secondary education most receive is small. As a result, access to post-secondary education is not likely to be the mechanism through which a GED leads to improved earnings for the average dropout. Our regression results bear this out.

III. Statistical Models and Estimation

Our exploration of the impact of the GED on subsequent earnings is based on two sets of regression models. The first set rests on the assumption implicit in past GED studies, including Cao, Stromsdorfer, and Weeks, that the relationship between the GED and earnings does not depend on the skills with which students left school. This model is depicted in equation 1:

Equation 1

$$y_i = \mathbf{b}_0 + \mathbf{yrsed}'_i \mathbf{b}_1 + \mathbf{a} GED_i + \mathbf{g} HSG_i + \mathbf{d} MATH_i + \mathbf{race}'_i \mathbf{b}_2 + \mathbf{region}'_i \mathbf{b}_3 + \mathbf{fambg}'_i \mathbf{b}_4 + \mathbf{V} \mathbf{yrpse}_i + \mathbf{miss9091} - \mathbf{y}'_i \mathbf{b}_5 + \mathbf{e}_{li}$$

where:

y_i = the average of 1990 and 1991 earnings,

\mathbf{yrsed}_i = a vector of two dummy variables indicating whether individual i finished the 10th or the 11th grade before dropping out (finishing the 9th grade is the omitted category),

GED_i = 1 if individual i has a GED, 0 otherwise,

HSG_i = 1 if individual i is a regular high school graduate,

$MATH_i$ = the score on a standardized mathematics test taken in the tenth grade by individual i ,

\mathbf{race}_i = a vector of dummy variables indicating whether individual i is black, Hispanic, or in the “other” race category (“white” is the omitted category),

\mathbf{region}_i = a vector of three dummy variables indicating whether the high school individual i attended was in the South, North Central, or Northeast United States (“West” is the omitted category),

\mathbf{fambg} = a two element vector of family background variables that include the highest level of education of individual i 's mother and the number of siblings in individual i 's family when in the tenth grade,

\mathbf{yrpse}_i = the number of years of post-secondary education attained by individual i as measured by transcript data,

$\mathbf{miss9091}_i$ = two dummy variables indicating whether or not the individual had missing earnings in either 1990 or 1991,

\mathbf{e}_i = a normally distributed, mean zero error term,

⁵ A table providing more details on the timing of GED receipt is available from the first author.

and the β 's, α , γ , δ , and θ are parameters to be estimated.

As stated earlier, Cao, Stromsdorfer, and Weeks used specifications that controlled for work experience. We fit models both with and without controls for accumulated work experience and its square.

The second set of regression models allows the relationship between educational credentials and earnings to differ by tenth grade math score. Equation 2 depicts the basic model:

Equation 2

$$y_i = \beta_0^* + \gamma \text{yrse}_i' \beta_1^* + \alpha^* \text{GED}_i + \gamma^* \text{HSG}_i + \delta \text{himath}_i + \mathbf{k}(\text{GED}^* \text{himath})_i + \mathbf{x}(\text{HSG}^* \text{himath})_i + \text{race}_i' \beta_2^* + \text{region}_i' \beta_3^* + \text{fambg}_i' \beta_4^* + \mathbf{z}^* \text{yrpse}_i + \text{miss9091}_i' \beta_5^* + \mathbf{e}_{2i}$$

where,

himath_i = a dummy variable indicating whether or not individual i was in the upper half of the distribution of tenth grade math scores,

$(\text{GED}^* \text{math})_i = 1$ if individual i has a GED and was in the upper half of the math score distribution and 0 otherwise,

$(\text{HSG}^* \text{math})_i = 1$ if individual i is a regular high school graduate and was in the upper half of the math score distribution, and

\mathbf{e}_{2i} = a normally distributed, mean zero error term,

and the β^* 's, α^* , γ^* , δ , γ , δ , and θ^* are parameters to be estimated.

Our models were fitted using ordinary least squares regression. Standard errors were computed using robust methods that do not depend on normality assumptions (White 1980). We weighted observations equally in fitting our models.

IV. Results

A. Models treating GED recipients as a single group

Table 3 presents parameter estimates and standard errors for a set of fitted models similar to equation 1. These models predict the impact of education credentials on log average annual earnings for a sample of females with positive earnings in either 1990 or 1991. All models control for years of completed schooling, race/ethnicity, region, and a set of family background characteristics. An important characteristic of these models is that the relationship between GED acquisition and log earnings is constrained to be the same for dropouts who left school with very weak skills as it is for dropouts who left with stronger skills. All of the models included in Cao, Stromsdorfer, and Weeks embody this constraint.

There are three basic messages from the fitted models in Table 3. The first is that there is no statistically significant difference in average log earnings between GED recipients and observationally similar uncredentialed dropouts (Models 1, 2, 3, and 4). The second is that GED recipients do not earn as much as conventional high school graduates in models that do not control for work experience (Models 1, 2, and 3). The third is there are no statistically significant differences in average earnings among uncredentialed dropouts, GED recipients, and conventional high school graduates, after differences in accumulated work experience are taken into account (Model 4). Cao, Stromsdorfer, and Weeks report this same pattern. The explanation is straight-forward: work experience pays off in the labor market, and conventional high school graduates have more work experience, on average, than do GED recipients, who, in turn, have more work experience than do conventional high school graduates. Comparisons of Model 2 and Model 3 show that these patterns are not sensitive to whether controls for children and marital status are included in the model.

We present the models in Table 3 to document that the patterns that Cao, Stromsdorfer and Weeks found in the NLSY and in data from Washington state are also present in the HSB data set. We do not dwell on these models because, as we show below, the assumption that the labor market value of the GED is independent of the skills with which female dropouts left high school is not valid.

B. Models distinguishing females by their 10th grade math scores

As displayed in Panel A of Table 4, predicted employment patterns are very different for females with relatively low 10th grade math scores than for those with higher tenth grade math scores. First, based on a logit model that does not control for marital status and children (Model 1), the predicted probability of a low skilled GED holder being employed at age 27 is about 18 percentage points greater than is the probability for a low skilled uncredentialed dropout ($p=0.000$). Meanwhile, females with low tenth grade math scores who graduated with a conventional high school diploma had a ten percentage point greater probability of working at age 27 than did low scoring GED holders ($p=0.002$).

Among females with relatively high tenth grade math scores, the pattern is different. Within this group, there is no statistically significant difference between the probabilities that female GED holders and dropouts without a GED were working at age 27 ($p=0.295$). However, females with relatively high tenth grade math scores who graduated with a conventional high school diploma were more likely to be working at age 27 than high scoring GED holders ($p=0.000$).⁶ These same patterns hold in Model 2 that includes controls for the presence of a child under five in the home, fertility, and marital status.

⁶ Among females with tenth grade test scores in the top half of the distribution, there was no statistically significant difference in the probability of working at age 27 between permanent dropouts and conventional high school graduates. However, there were only 25 females with tenth grade math scores in the top half of the test score distribution who became permanent dropouts.

As shown in Panel B of Table 4, the relationships between educational credentials and accumulated work experience are different for females with low tenth grade math scores than for females with high tenth grade scores. The estimated parameters of Model 1 (that does not account for child and marital status) indicate that low skilled GED holders accumulate about 1.4 years more work experience by age 27 than do low skilled uncredentialed dropouts. However, there is no difference between the accumulated work experience of high skilled GED holders and high skilled uncredentialed dropouts ($p=0.949$). These same patterns hold when the predictions are based on a model that controls for marital status and children (Model 2).⁷

Table 5 presents parameter estimates and standard errors for a set of fitted models that allow the impact of GED acquisition on subsequent log earnings to be different for dropouts who left school with low math scores than for dropouts that left school with higher math scores. The most important pattern displayed in the table is that among dropouts who left high school with low math scores, those who obtained a GED had 25 percent higher earnings at age 27 than uncredentialed dropouts who were working at age 27 ($p=0.053$).⁸ In contrast, among dropouts who left high school with higher math scores and were working at age 27, there was no statistically significant difference in earnings at that age between those who had obtained a GED and those who had not [$H_0: \text{GED} + \text{GED} \times (\text{high math score}) = 0$, $p=0.460$]. The patterns are the same in Model 2 that controls for post-secondary education. While controlling for family structure (Model 3) reduces the point estimate of the GED effect for low skilled dropouts, the effect is still relatively large though statistically insignificant in this model.

⁷ There is also no difference in the accumulated work experience of high scoring GED holders and low scoring GED holders. A likely reason for this is that high scoring GED holders spent more time on average in post-secondary education between 1980 and 1992 than did low scoring GED holders (about 1.0 versus 0.37 mean years of post-secondary education, respectively).

⁸ The 25 percent earnings differential is calculated as $e^{.25} - 1$

As one would expect from the results in Table 4, work experience is the likely critical mechanism through which educational credentials translate into higher earnings for females. For neither females with low tenth grade math scores nor females with high tenth grade scores could we reject the null hypothesis (at the .05 level) of no significant differences in log earnings among permanent dropouts, GED holders and conventional high school graduates, when estimated in Model 4, which controls for work experience.⁹

Table 6 displays models in which the dependent variable is the average of 1990 and 1991 earnings as described earlier. The sample used to fit these models includes the 585 females with no labor market earnings during these years. All models displayed in Table 6 include separate estimates of credential effects for females with low tenth grade math scores and for females with higher tenth grade scores. Model 1 indicates that GED holders who scored in the bottom half of the math score distribution had annual earnings almost \$3,300 dollars higher than observationally similar uncredentialed dropouts with low tenth grade math scores ($p=0.000$). In contrast, higher scoring GED holders had annual earnings that were not statistically different from higher scoring uncredentialed dropouts ($p=0.232$.)

GED recipients do not earn as much at age 27 as observationally similar conventional high school graduates. This is the case both among females with low tenth grade math scores and among females with higher tenth grade math scores (Model 1: $p=0.000$ and $p=0.000$, respectively).

Model 2 controls for years of post-secondary education. Since both GED holders and uncredentialed dropouts accumulate so little post-secondary education, the comparisons between

⁹ Reduced welfare participation is another mechanism through which educational credentials might improve labor market outcomes. Indeed, when we include an indicator for whether or not a sample member received any public assistance monies in 1991, the estimated GED effect is slightly smaller in all models (though never so small as to be

these two groups are little changed from Model 1. The estimated benefit associated with a conventional high school diploma is reduced in Model 2, indicating that improved access to post-secondary education is an important mechanism through which this credential pays off in the labor market.

Comparison of Model 3 with Model 2 shows that our basic results—low skilled dropouts with a GED have higher estimated earnings than low skilled dropouts without the credential—is not sensitive to whether differences in fertility and marital status are taken into account. And again, earnings premia associated with both a GED and a high school degree are not present in models that control for work experience (Model 4).

C. Selectivity Bias

We have interpreted our results as indicating that acquisition of a GED enables females who dropped out of school with weak cognitive skills, as measured by scores on a basic math test, to accumulate more work experience than they would have and through this to earn more at age 27 than they otherwise would have. However, there is another possible explanation of the empirical evidence. Consider two female dropouts, Mary and Jane. Jane plans to work, even if she has children, while Mary has preferences for staying home, especially if she has children. Assume that both Mary and Jane have the same human capital endowments and lifetime earning potential. It may be that because of her preferences for work Jane obtains a GED and has more work experience by age 27 than Mary. If Mary decides to go to work at that point, then her lack of work experience will likely translate into lower earnings than Jane's. In this case, however, it

statistically insignificant). However, our view is that post-GED experiences such as welfare participation should not be controlled for in models that attempt to estimate the total effect of the GED on outcomes.

would be inappropriate to attribute the difference between Jane's and Mary's earnings to GED acquisition, since it may simply reflect differences in their preferences.¹⁰

The Jane and Mary example is an example of selectivity bias. While Jane and Mary are observationally similar, they differ in an unobserved dimension, in this case preference for work, that is correlated both with the probability that they obtain GEDs and with their subsequent earnings. Selectivity bias is not a new problem in the GED literature. Because of data that lacked suitable instrumental variables for GED attainment, almost all previous studies, including Cameron and Heckman (1993), Cao, Stromsdorfer, and Weeks (1996), and Murnane, Tyler, and Willett (2000) and this study have been unable to satisfactorily address this potential problem. The one paper in the GED literature that has dealt with potential selection bias is the Tyler, Murnane, and Willett (2000) study that employs a quasi-experimental approach to estimating the causal effect of the GED on earnings. It is notable that our estimates are consistent with the findings of Tyler, Murnane, and Willett.

V. Conclusion

Previous work by Cao, Stromsdorfer, and Weeks found that female GED recipients did not have better subsequent labor market outcomes than observationally similar female dropouts without a GED. Using newer data we reproduce their basic findings. We then raise questions about two assumptions underlying their empirical work, namely, that the impact of the GED on subsequent earnings is the same for all female dropouts and that it is appropriate to control for work experience in models examining the impacts of educational credentials on subsequent earnings.

¹⁰ We thank an anonymous reviewer for this illustrative example.

We show that among dropouts who left school with low math scores, those who subsequently obtained a GED earned, on average, \$3300 more at age 27 than those who did not. We also show that the primary explanation for this earnings difference is that those women who acquired a GED accumulated much more work experience than those who did not, and were more likely to be working at age 27 than those who did not. We also show that among female dropouts who left school with higher math scores, there are no statistically significant earnings differences at age 27 between those who obtained a GED and those who did not.

With the data available to us we cannot determine why the GED is associated with greater subsequent earnings for females who leave school with very weak cognitive skills, as measured by math test scores, but not for those who leave school with stronger cognitive skills. However, we suggest the following two explanations. First, females who dropped out of school with relatively strong cognitive skills may have already established labor market connections—for example, they had a part time job and the employer offered full-time employment. Or they may have returned to established employment after bearing a child. In contrast, dropouts with low cognitive skills are the least attractive job applicants for most employers. Among the reasons are that the poor attendance, tardiness, and inconsistent work habits that result in poor cognitive skills in school also makes these dropouts unattractive employees. Many low skilled dropouts mature and become potentially better employees. However, they are hampered by their past employment record. Passing the seven and one-half battery of GED exams may signal to potential employers that matured low skilled dropouts have acquired a minimum level of competency in reading, writing, and mathematics, as well as a certain amount of responsibility and persistence. In other words, acquisition of the credential may provide females who left

school with weak cognitive skills improved access to the types of jobs held by female dropouts who left school with stronger skills

An alternative explanation rests on the assumptions that employers can observe the skills of dropouts and that dropouts are making human capital investment decisions when they consider whether to pursue a GED.¹¹ In this case studying for the GED contributes to one's human capital, and those who leave school with very weak basic math skills have to study more to pass the GED than do those who leave school with higher levels of skills. At the margin the increase in human capital is important for those who leave school with weak skills. For those who begin the GED process with higher skills, however, the increase in human capital at the margin is so small as to be statistically insignificant. In the face of no return to obtaining a GED, higher skilled dropouts continue to pursue the GED because of the very costs for these dropouts. The direct costs associated with taking the GED are between zero and \$50 depending on the state, and the opportunity costs associated with obtaining the credential would be expected to be low for those who can pass it with relative ease.

¹¹ We thank an anonymous reviewer for pointing out this alternative explanation.

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Data Appendix

High School and Beyond Data

Sample Selection

The data used in this paper are from the *High School and Beyond* national longitudinal survey of 14,825 individuals who were in the 10th grade in 1980. To be included in our sample, females in the survey had to have participated in both the 1980 base year survey and in the fourth follow-up survey conducted in 1992. In Table 1A below we tabulate the results of this and other sample selection decisions that were made to create the final analytic sample of 4,785 females used in this paper.

Table 1A. Construction of the analytic sample.

Decision Rule	Number of total individuals not meeting the criterion	Number of individuals left in the sample
Member of base year survey	—	14,825
Member of 4 th follow-up survey	2,185	12,640
Able to identify the observation as either a regular high school graduate, GED-holder, or dropout as of 4 th follow-up survey. ¹	376	12,264
Able to identify the date that GED-holders left high school and this date occurs before the date they obtained their GED	46	12,218
Female	5,880	6,338
Able to identify date that GED-holder obtained the credential	30	6,308
Not in the military in 1992	8	6,300
Not in college in both 1990 and in 1991	304	5,996
1990 and 1991 earnings are in a plausible range	61	5,935
Both 1990 and 1991 earnings are observed	492	5,443
1980 Sophomore math test score is		

1. Below we discuss the process by which we identified the education status of individuals.

Table 2A gives the distribution of our analytic sample across the different types of educational certification.

Table 2A. Distribution of high school graduates, GED-holders, and permanent dropouts.

Type of certification	Frequency	Percent
Regular high school graduates	4,213	88.1
GED-holders	266	5.6
Permanent dropouts	<u>298</u>	<u>6.4</u>
Totals	4,785	100.0

Identification of Education Status

The GED is commonly referred to as a “high school equivalency” certificate. Thus, GED-holders may equate obtaining a GED with graduating from high school, making it unclear how they would answer a survey question about high school completion. There is only one secondary-education-status question in the four *High School and Beyond* surveys that specifically asks respondents whether or not they have earned a GED, and as a result, identification of true GED-holders in the *High School and Beyond* data is not straightforward. Responses to that question, which was asked in the third follow-up survey (1986), are coded into variable TY18 in the *High School and Beyond* data.

Our secondary-education-status identification strategy begins with variable TY18. The 831 males and females who identified themselves as GED-holders on this question were all coded as GED-holders in our project, unless high school transcript data disagreed with the self-reported status. Remaining to be resolved were (1) establishing that individuals who called themselves high school graduates on TY18 were, indeed, regular high school graduates, (2) resolving the secondary-education-status of individuals who either indicated they were still in high school in 1986 or whose values on TY18 were missing or invalid, (3) establishing the secondary-education status of individuals who did not participate in the third follow-up (1986) survey, and (4) establishing the final (as of 1992) secondary-education status of individuals who indicated on

TY18 that they had no diploma or certification as of 1986. In Table 3A below, we present the variables in *High School and Beyond* that we used to resolve each of these issues.

Table 3A. Variables used to identify secondary-education-status in our analytic sample.

Issue	<i>High School and Beyond</i> variables
Establish initial secondary-education status	TY18
Verify that self-reported high school graduation status on TY18 matches transcript data.	TRSTTYPE, HSDIPLOM
Establish secondary-education status of those with TY18 missing or invalid.	SY12
Establish the secondary-education status of those who either (1) still had an indeterminate education status as of 1986 or (2) who did not have GED as of 1986, but who obtained the credential by 1992.	Y4202B, TRSTTYPE
Use a 1992 question on whether individuals are “...still working toward a diploma, GED, or certification” to identify inconsistencies	Y4201
Use transcript data and date-left-school data to verify high school graduation status and clear up further inconsistencies	TRSTTYPE, DTLEFT

Using these variables and a relatively complex algorithm we were able to sort the 14,825 members of the *High School and Beyond* sample into the categories in Table 4A below.

Table 4A. Distribution of complete (males and females) *High School and Beyond* sample by secondary-education status.

Type of certification	Frequency	Percent
Status never positively determined	623	4.0
Regular high school graduates	11,807	79.6
GED-holders	1,130	7.6
Permanent dropouts	867	5.6
Conflicts in status, left unidentified	<u>398</u>	<u>2.7</u>
Totals	14,825	100.0

Thus, we are unable to positively identify about 7 percent of the entire *High School and Beyond* sample. However, when we limit our sample to only females who participated in the fourth follow-up (1992), the percentage of individuals for whom we cannot identify the secondary-education status is only about 3 percent.

References

- Angrist, J. D. & Evans, W. N. (1998). Children and Their Parents' Labor Supply: Evidence from Exogenous Variation in Family Size. *American Economic Review* 88 (3), 450-477.
- Boudett, K. P. (2000). "Second Chance" Strategies for Women Who Drop Out of School. *Monthly Labor Review* December, 19-31.
- Cameron, S. V. & Heckman, J. J. (1993). The Nonequivalence of High School Equivalents. *Journal of Labor Economics* 11 (1), 1-47.
- Cao, J., Stromsdorfer, E. W. & Weeks, G. (1996). The Human Capital Effect of the GED on Low Income Women. *Journal of Human Resources* 31 (1), 206-228.
- Gottschalk, P. (1997). Inequality, Income Growth, and Mobility: The Basic Facts. *The Journal of Economic Perspectives* 11 (2), 21-40.
- Korenman, S. & Neumark, D. (1992). Marriage, Motherhood, and Wages. *Journal of Human Resources* 27 (2), 233-255.
- Murnane, R. J., Willett, J. B. & Tyler, J. H. (2000). Who Benefits from a GED? Evidence from *High School and Beyond*. *The Review of Economics and Statistics* 82 (1), 23-37.
- Nakamura, A. & Nakamura, M. (1994). Predicting Female Labor Supply. *Journal of Human Resources* 29 (2), 302-327.
- Neal, D. A. & Johnson, W. R. (1996). The Role of Premarket Factors in Black-White Wage Differences. *Journal of Political Economy* 104 (5), 869-895.
- Spence, M. (1973). Job Market Signaling. *Quarterly Journal of Economics* 87, 355-374.
- Tyler, J. H., Murnane, R. J. & Willett, J. B. (2000). Estimating the Labor Market Signaling Value of the GED. *Quarterly Journal of Economics* CXV (2), 431-468.
- White, H. (1980). A Heteroscedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity. *Econometrica* 48, 817-838.

Table 1. Descriptive statistics of the analytic sample of 4,785 females from the *High School and Beyond* data set. (Standard deviations in parentheses.)

	Conventional HS graduates	GED- holders	Permanent dropouts	All
Number of observations	4,213	266	306	4,785
Mean...				
years of post secondary education	2.82 (2.72)	0.54 (1.12)	0.05 (0.28)	2.51 (2.70)
years of completed schooling, mother	12.70 (2.21)	11.69 (1.77)	11.20 (1.56)	12.54 (2.19)
number of siblings when a sophomore	2.92 (1.73)	3.14 (1.82)	3.96 (1.88)	3.00 (1.77)
years of work experience	7.41 (2.32)	5.64 (2.98)	4.16 (3.23)	7.10 (2.58)
sophomore math test score	13.86 (9.13)	8.09 (8.00)	3.45 (5.42)	12.87 (9.31)
log avg. 1990 and 1991 earnings	9.69 (0.80)	9.09 (1.08)	8.89 (1.07)	9.62 (0.86)
average 1990 and 1991 earnings	18,019 (12,050)	10,328 (10,155)	6,863 (9,371)	16,878 (12,211)
average positive earnings	19,972 (11,042)	13,083 (9,724)	11,111 (9,747)	19,229 (11,165)
percent with zero earnings	9.78	21.1	38.2	12.23
Fraction...				
who completed grade 9	0	0.13	0.16	0.02
who completed grade 10	0	0.46	0.50	0.06
who completed grade 11	0	0.41	0.34	0.04
who completed grade 12	1.00	0.00	0.00	0.88
white	0.66	0.67	0.54	0.65
black	0.12	0.09	0.15	0.12
Hispanic	0.18	0.20	0.28	0.19
in other race category	0.04	0.04	0.02	0.04
missing 1990 earnings	0.09	0.11	0.08	0.09

missing 1991 earnings	0.05	0.06	0.04	0.05
in the low math category	0.45	0.75	0.92	0.49
in the high math category	0.55	0.25	0.08	0.51

Table 2. Amounts and types of post-secondary education by educational credential for the analytic sample of 4,785 females in the *High School and Beyond* data set.

	Conventional HS graduates	GED holders	Uncredentialed dropouts
Fraction with...			
zero years of post-secondary	0.28	0.66	0.94
0<years<1 of post-secondary	0.12	0.16	0.04
1<=years<2 of post-secondary	0.10	0.07	0.01
2<=years<3 of post-secondary	0.09	0.07	0.01
3<=years<4 of post-secondary	0.06	0.02	0.00
4 or more years of post-secondary	0.37	0.02	0.00
Mean years of post-secondary education	2.81 (2.72)	0.52 (1.10)	0.05 (0.30)
Fraction with at least one credit in ...			
a 4-year college	0.51	0.08	0.00
a 2-year college	0.36	0.27	0.06
a non-college training program	0.05	0.06	0.02

Table 3. Log earnings regression for those with positive average 1990-1991 earnings.

	Model 1	Model 2	Model 3	Model 4
Intercept	8.605** (0.15)	8.82** (0.15)	9.226** (0.15)	7.305** (0.20)
GED	0.101 (0.106)	0.107 (0.107)	0.070 (0.103)	-0.029 (0.089)
Conventional high school graduate	0.457** (0.130)	0.374** (0.130)	0.259** (0.123)	-0.022 (0.118)
Math score ^a	Yes	Yes	Yes	Yes
Years of post-secondary education		Yes	Yes	Yes
Controls for presence of a child under five, number of children in 1992, and marital status			Yes	Yes
Controls for work experience and experience squared				Yes
R-squared	0.116	0.143	0.211	0.341
N	4,200	4,200	4,200	4,200
p-value:				
H ₀ : 11 years of schooling + GED = high school graduate	0.000	0.004	0.109	0.321

a. All models also controlled for race/ethnicity, region, mother's education, sibling status while in high school, whether or not the individual was missing earnings information in either 1990 or 1991, and highest grade completed before dropping out.

Table 4. Predicted working probabilities and years-of-work regressions allowing differential effects by math score.

Panel A: Predicted Probability of Working in 1990 or 1991 ^a		
	Model 1	Model 2
Low math scores:		
Permanent dropouts	0.59	0.70
GED holders	0.77	0.85
Conventional high school graduates	0.87	0.90
High math scores		
Permanent dropouts	0.87	0.93
GED holders	0.77	0.85
Conventional high school graduates	0.93	0.94
Controls for child under five, number of children in 1992, and marital status ^b		Yes
p-values:		
H ₀ : Low scoring dropout = low scoring GED	0.000	0.007
H ₀ : Low scoring GED = low scoring high school graduate	0.002	0.203
H ₀ : High scoring dropout = high scoring GED	0.295	0.236
H ₀ : High scoring dropout = high scoring high school graduate	0.268	0.706
H ₀ : High scoring GED = high scoring high school graduate	0.000	0.027
Panel B: OLS Regressions, Dependent Variable: Years of Accumulated Work Experience, 1982-1992		
	Model 1	Model 2
Intercept	4.541** (0.421)	6.313** (0.406)
High math score dummy	1.702** (0.605)	1.758** (0.572)
GED	1.408** (0.287)	1.295** (0.272)
Conventional high school graduate	3.308** (0.370)	2.510** (0.350)
GED X (high math score)	-1.451* (0.732)	-1.631* (.689)
(Conventional high school graduate) X (high math score)	-1.108~ (0.609)	-1.389* (0.576)
Controls for child under five, number of children in 1992, and marital status ^b		Yes
R-squared	0.148	0.239
p-values:		
H ₀ : Low scoring GED + 11 years of education = low Scoring high school graduate	0.000	0.007
H ₀ : High scoring dropout = High scoring GED	0.949	0.595
H ₀ : High scoring dropout = High scoring high school graduate	0.268	0.706

H ₀ : High scoring GED + 11 years of education = high Scoring high school graduate	0.000	0.009
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a. The predicted probabilities were calculated using the estimated logit coefficients, setting all variables equal to their mean values.

b. All models also controlled for race/ethnicity, region, mother's education, sibling status while in high school, whether or not the individual was missing earnings information in either 1990 or 1991, and highest grade completed before dropping out.

c. ~ = p<0.10, * = p<0.05, ** = p<0.01

Table 5. Log earnings regression for those with positive average 1990-1991 earnings, allowing differential effects by math score.

	Model 1	Model 2	Model 3	Model 4
Intercept	8.574** (0.151)	8.803** (0.151)	9.201** (0.149)	7.282** (0.200)
GED	0.223~ (0.115)	0.208~ (0.115)	0.172 (0.112)	0.055 (0.095)
Conventional high school graduate	0.528** (0.130)	0.423** (0.130)	0.312** (0.124)	0.021 (0.119)
High math score	0.399~ (0.237)	0.396~ (0.240)	0.434* (0.211)	0.372~ (0.198)
GED X (high math score)	-0.428 (0.301)	-0.479 (0.303)	-0.508~ (0.285)	-.461~ (0.253)
(Conventional high school graduate) X (high math score)	-0.140 (0.238)	-0.266 (0.241)	-0.309 (0.233)	-0.307 (0.199)
Years of post-secondary education ¹		Yes	Yes	Yes
Controls for presence of a child under five, number of children in 1992, and marital status			Yes	Yes
Controls for work experience and experience squared				Yes
R-squared	0.108	0.142	0.209	0.341
N	4,200	4,200	4,200	4,200
p-values:				
H ₀ : Low scoring dropout = Low scoring GED	0.053	0.071	0.126	0.561
H ₀ : Low scoring GED + 11 years of Education = low scoring high school Graduate	0.002	0.018	0.249	0.528
H ₀ : High scoring dropout = high scoring GED	0.460	0.333	0.200	0.086
H ₀ : High scoring GED + 11 years of Education = high scoring high school Graduate	0.001	0.009	0.067	0.171

a. All models also controlled for race/ethnicity, region, mother's education, sibling status while in high school, whether or not the individual was missing earnings information in either 1990 or 1991, and highest grade completed before dropping out.

Table 6. Earnings regression for 1990-1991 earnings (including zero earnings), allowing differential effects by math score.

	Model 1	Model 2	Model 3	Model 4
Intercept	-1342 (1536)	2438~ (1546)	8227** (1545)	-4423** (1400)
GED	3290** (822)	3112** (825)	2701** (801)	15 (630)
Conventional high school graduate	8296** (1091)	6791** (1098)	5283** (1041)	-14 (868)
High math score	8812* (3735)	8790* (3772)	9046* (3597)	5391 (3392)
GED X (high math score)	-8056* (4063)	-8801* (4097)	-9079* (3919)	-5811 (3630)
(Conventional high school graduate) X (high math score)	-3900 (3751)	-6103 (3789)	-6509~ (3612)	-3974 (3405)
Controls for race/ethnicity	Yes	Yes	Yes	Yes
Years of post-secondary education		Yes	Yes	Yes
Controls for presence of a child under five, number of children in 1992, and marital status			Yes	Yes
Controls for work experience and experience squared				Yes
R-squared	0.108	0.142	0.209	0.341
N	4,785	4,785	4,785	4,785
p-values:				
H ₀ : Low scoring dropout = Low scoring GED	0.000	0.000	0.001	0.981
H ₀ : Low scoring GED + 11 years of Education = low scoring high school Graduate	0.000	0.011	0.096	0.825
H ₀ : High scoring dropout = high scoring GED	0.232	0.158	0.098	0.107
H ₀ : High scoring GED + 11 years of Education = high scoring high school graduate	0.000	0.000	0.006	0.169