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Earnings, Education, and Experience

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Introduction

When the decision to obtain additional education is based on future financial gain, an individual must determine the expected return less the cost of that education versus the net return to no further education. This decision is not unlike other investment decisions requiring a person to incur a current cost in anticipation of future returns. Typically, economists measure the return to education using an empirical earnings function based on the specification in Mincer (1974). Such earnings specifications are also used to measure wage differences between occupations, races, sexes, and so on. Moreover, the estimates taken from earnings equations are often used to guide policy. Unexplained earnings differences across race or sex, for example, have spurred legislation to correct such "discrimination." Although the general patterns that emerge are consistent for a wide variety of specifications, the individual point estimates are not. Therefore, proper specification of the earnings equation is extremely important if inferences are to be drawn from the estimates.

For more than 20 years, the Mincer-type specification has been the workhorse of labor economists studying the determinants of earnings. Not surprisingly, it has also been the object of much scrutiny aimed at uncovering any shortcomings it may have. In this article, we examine a standard Mincer empirical earnings function, concentrating on the return to education as measured by the increase in income resulting from that education. In so doing, we address several issues. The first is determining how education should enter into a statistical framework, so that the return to years of schooling can be correctly inferred from the data. The second issue is that of separating the return to education from other effects, such as experience.

In particular, we show that combining into one category individuals who have attained a college degree and those who have some postgraduate education leads to an upward bias in the measured return to a college education. Furthermore, this problem is exacerbated as the percentage of the population with more than a bachelor's degree increases. Although it is well known that more and more people are continuing their education past the college level, earnings specifications that do not separate individuals with graduate course work from those with only an undergraduate degree are quite common; therefore, results from such studies should be used with caution. We also show that

FIGURE 1

Log of Real Median Weekly Earnings, 1993

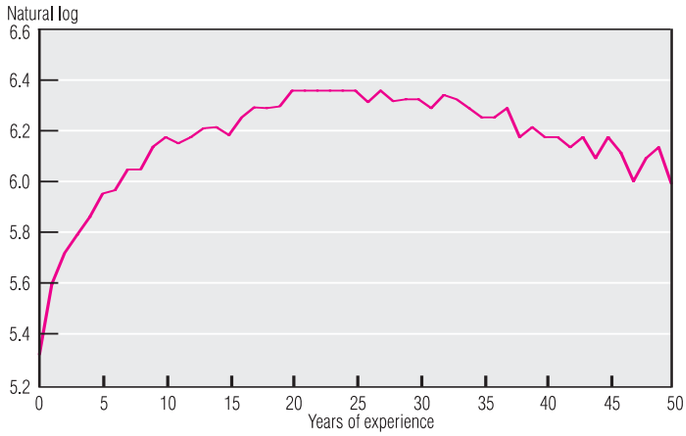
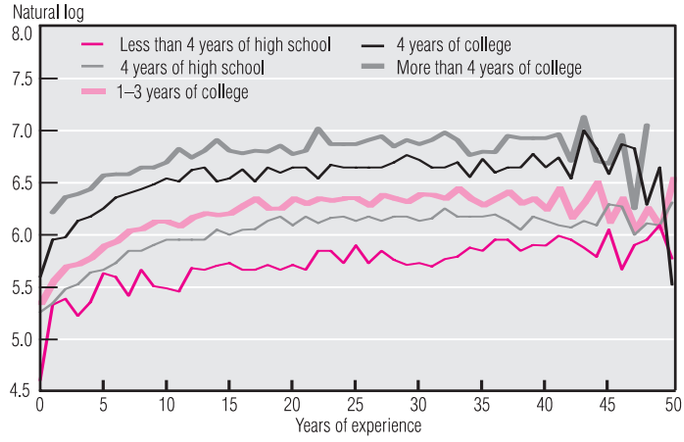


FIGURE 2

Log of Real Median Weekly Earnings by Educational Level, 1993



NOTE: Data refer to full-time U.S. workforce.
SOURCE: March Current Population Survey, 1994.

specifications using linear "years of education" may be misleading, because the largest gains in earnings come in discrete jumps upon the attainment of a degree, whether high school, college, or beyond.

Studies measuring the return to education, such as Juhn, Murphy, and Pierce (1993), show that the relative earnings of high-school- and college-educated individuals have become more disparate over time. This growing divergence arises from two effects. First, the absolute return to a college education has been increasing. Second, as mentioned above, the number of people pursuing post-graduate education has also been rising. We reiterate that failure to control for the latter (that is, combining the effect of undergraduate and post-graduate work) will lead to an overestimate of the return to a college education. Although this approach may bias the results only slightly if data from the 1960s are used (because there were relatively few post-college graduates then), the same cannot be said if more recent data are employed. We find this bias to be in the neighborhood of 12 percent.

The remainder of the paper is laid out as follows. The first section presents some basic facts concerning earnings, education, and experience. Section II describes our alternative specifications for earnings. In section III, we present our empirical results. Section IV concludes.

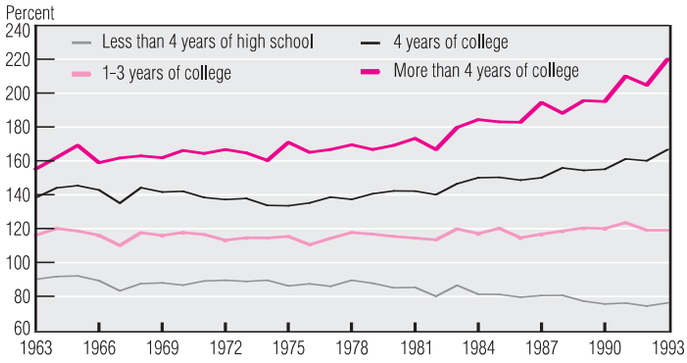
I. Earnings, Education, and Experience: The Basic Facts

Figure 1 displays the relationship between wages and experience based on the Census Bureau's March 1994 Current Population Survey (CPS), which summarizes 1993 earnings. Initially, wages rise with experience, but then begin to fall. Because the data are based on a cross-section, one reason for the profile's concave shape is that individuals with more experience are generally older and less educated than younger people. Another reason is that skills depreciate over an individual's lifespan. Thus, we see the same basic shape even within educational levels, although rates of investment and depreciation may vary across them (see figure 2). We discuss these issues in more detail below, but it should be clear at this stage that the effects of experience must be separated from those of education. Inadequate controls for experience contaminate the measured return to education.

Figure 2 shows that, on average, earnings rise with the level of education. Figure 3 presents this information in a slightly different way, graphing earnings by education level relative to those of high school graduates. Several interesting relationships are apparent. First, note that none of the lines cross, indicating that, on average, higher levels of education lead to higher earnings. Second, the lines diverge over time, meaning that the return to a college degree, relative to high school, increases throughout the years. Part of this effect occurs because the earnings of high school graduates have been falling in real terms.

FIGURE 3

Log of Real Median Weekly Earnings by Educational Level as a Share of High School Graduates' Earnings, 1963–93



NOTE: Data refer to full-time U.S. workforce.
SOURCE: March Current Population Survey, 1964–94.

Median (gross) earnings for college graduates (16 years of education) are roughly 60 percent higher than those of high school graduates (12 years of education), while high school dropouts earn about 32 percent less than individuals who have a high school diploma.[1]

II. Specification

Estimates taken from earnings regressions are often used to formulate statements that may have substantial policy relevance. Although potential biases exist in the articles mentioned below, we do not claim that such biases necessarily affect the studies' overall conclusions. Nor do we attempt to measure such biases, since their extent will depend on correlations with the education variables. Below, we show how different education specifications may affect sex- and race-based earnings estimates.

In a recent paper, Schmitz, Williams, and Gabriel (1994) examine race and sex differences in wage distributions using years of education (linear) as one of their explanatory variables. They conclude that there are differences in the distributions and attribute these differences to "... the impact of differential treatment in the labor market." Obviously, any bias in the education specification may affect the measured differences in distributions.

Dooley and Gottschalk (1984) examine trends in earnings inequality among male cohorts over the 1968–79 period. They show that earnings differences may be affected by changes in the size of the labor force. Their preferred earnings specification uses dummy variables for education levels, but combines college and post-college as one group.

Fairlie and Meyer (1996) look at several explanations for the disparity in self-employment rates across race and ethnic backgrounds. Although they find that higher education leads to a greater probability of being self-employed, their specification contains three categories for education: high school graduate, some college, and college graduate. If there are racial or ethnic differences in educational attainment, then their estimates are potentially biased.

Bar-Or et al. (1995) use Canadian data to measure the return to a university education from 1971 to 1991. They find that the return declined during the 1970s and did not rebound much during the 1980s. Throughout their paper, they use two groups: university graduates and those who have completed 11 to 13 years of education (with no post-secondary schooling).

The standard model relating education, experience, and earnings is based largely on the work of Mincer (1974). Optimal investment in human capital (formal schooling and post-school learning) is based on a maximization problem that compares the net present value of earnings for an additional year of schooling, for example, to that of no additional investment. A similar maximization problem is undertaken for post-school investment.

Mincer's model compares the present value of s years of schooling to that of $s-d$ years of schooling. First, calculate the present value of an individual's lifetime earnings at the start of formal education:

$$(1) \quad V_s = Y_s \sum_{t=s+1}^{n} \frac{1}{(1+r)^t},$$

where Y_s is the annual earnings of an individual with s years of schooling, r is the discount rate the individual uses to discount the future,[2] and n is the length of working life, which, by assumption, is independent of the amount of schooling. Next, calculate V_{s-d} to obtain the present value of $s-d$ years of schooling. Comparing V_s to V_{s-d} and applying some algebra leads to[3]

$$(2) \quad y_{it} = \alpha_0 + \alpha_1 ED_{it},$$

■ **1** To examine the net return to education, direct and indirect costs of acquiring that education must be deducted.

■ **2** Another way of saying this is that r represents the return necessary to delay earning in order to learn.

■ **3** To be correct, the actual derivation is performed using the continuous-time analogue of equation (1).

where y_{it} is the log of earnings for individual i at time t, and ED is a measure of education. Note that in this particular specification, α_0, the constant term, can be interpreted as Y_0, $\alpha_1 = r$. If post-schooling investments are also considered, then optimization would give us a declining rate of investment in human capital over time. This result follows from the fact that there is less time to recoup investments in education as age increases; that is, as one gets older, more time is spent earning and less time is spent learning.

The conventional empirical method of capturing declining investments over time is to specify the earnings equation using a quadratic term in experience:

$$(3) \quad y_{it} = \alpha_0 + \alpha_1 ED_{it} + \alpha_2 EX_{it} + \alpha_3 EX_{it}^2 + \gamma Z_{it} + \varepsilon.$$

Controls for other relevant factors that may influence earnings in a systematic way are also included. The matrix Z in equation (3) represents these other factors and includes such variables as sex and race. ε is assumed to be an independent and identically distributed error term reflecting unobservables as well as possible measurement error.

Note that a negative value of α_3 gives rise to a concave shape of the experience–earnings profile, similar to that in figure 1. This particular parametric functional form imposes strong restrictions on how investments decline over time (more flexible specifications will be examined below). The concave shape arises from the assumption of linearly declining investments (either dollar investments or the ratio of investments to earnings). If one assumes (as Mincer and nearly everyone else does) that experience is continuous and begins immediately after completion of schooling, then it can be measured as age minus years of schooling minus the age at which schooling begins.[4] Typically, experience is defined as age minus education minus six.

Perhaps more important than the specification of experience is the specification of the education variable itself. Commonly, this variable is included in an earnings regression in categorical form. More specifically, it is included as a dummy variable indicating whether an individual is a high school dropout, has a high school diploma, has completed some college, or has a bachelor's degree or more. The last category is the one typically not considered in earnings specifications. Another approach is to include a continuous variable for education, that is, years of education. However, this specification does not capture the large gains that occur at discrete points, namely, when a degree is obtained.

Equation (3) represents the most common specification used to uncover the factors explaining earnings. Although the estimating equation arises from optimizing investment behavior, several issues regarding the form of the equation do not. Specifically, how should experience and education enter the equation?

As mentioned above, if one assumes that post-schooling investment begins immediately after graduation and is continuous, then investment will decline as one ages. The question arises as to the form of this drop-off. The most commonly used is that of linearly declining investments over time, which leads to the experience-squared term in equation (3). This particular specification arises merely by assumption and is not based on any underlying theory. Obviously, imposing an incorrect functional form can lead to a misspecification of the model, in turn leading to a bias in the return to experience and possibly to other variables. Furthermore, this specification does not fit the data very well. Murphy and Welch (1990) experiment with several forms for experience and eventually find that a fourth-order polynomial (quartic) does fit the data reasonably well.

Our strategy for the experience control is to admit at the outset that we have little a priori information about its specification, so we allow it to be an arbitrary smooth function. We apply the semiparametric procedure of Robinson (1988) to the data and estimate the parameters of interest.

A potentially more important issue, however, is determining how education should enter the equation. As noted above, many studies include education as a categorical variable representing discrete levels of schooling. This specification produces the result one would expect: More education leads to higher earnings. However, as an increasing number of individuals pursue post-graduate studies, such a specification will lead to an overestimate of the return to a college education. A similar situation also exists for persons who did not complete high school. Early in the survey period, many of these noncompletions were individuals with an elementary education or less, whereas only a few workers fell into this category in the 1994 CPS.

4 Although actual work experience should be in the equation, data limitations make it necessary to use potential experience.

TABLE 1

Summary Statistics, 1963 and 1993

	1963		1993	
Variable	Mean	Standard Deviation	Mean	Standard Deviation
High school dropout	0.42	0.49	0.11	0.31
High school graduate	0.36	0.48	0.34	0.47
Some college	0.10	0.30	0.28	0.45
College graduate	0.07	0.25	0.18	0.38
Post-college graduate	0.03	0.19	0.09	0.28
Years of education	11.10	3.20	13.40	2.60
Real wage and salary earnings	$23,806	$35,612	$28,957	$19,562
Years of experience	24.10	13.60	19.80	11.70
Black	0.08	0.28	0.09	0.28
White	0.91	0.29	0.86	0.35
Other nonwhite	0.01	0.09	0.05	0.22
Female	0.28	0.45	0.42	0.49

SOURCE: Authors' calculations based on the March Current Population Survey, 1964 and 1994.

This would tend to inflate the relative wage changes of high school dropouts.

Another common specification includes earnings as a linear function of years of education. However, a large part of the return to education occurs when a degree is actually earned, so that a graph of education and earnings would resemble a step function. Another way of saying this is that the return to stopping one's formal education as a junior in college is not much different from the return to stopping as a sophomore. Below, we quantify these biases by including a separate term for various education levels.

III. Data and Results

Our data are taken from the March CPS and consist of full-time workers only. Table 1 presents summary statistics for 1963 and 1993. Note that the change in educational attainment over this time span is quite remarkable. In 1963, 42 percent of the full-time workforce consisted of high school dropouts; by 1993, that figure had fallen to 11 percent. The fraction of workers with only a high school diploma also declined over this period, from 36 to 34 percent. By contrast, the share of the workforce holding a college degree rose substantially, from 7 to 18 percent, and the fraction with some post-graduate studies shot up from 3 to nearly 9 percent. Note that the change in measured experience fell by about four years, from 24.1 to 19.8. This decline in labor market experience is at least partially explained by the additional years of schooling, since experience is measured as age minus years of education minus six.

In terms of demographics, the share of blacks in the full-time workforce did not change much, rising from 8.3 percent in 1963 to 8.8 percent in 1993. However, the fraction of whites dropped off somewhat, from 91 to 86 percent. The difference is made up by other nonwhites, whose share grew from slightly less than 1 to just over 5 percent. Females made up close to half of the labor force in 1993 (42 percent), up from 28 percent three decades earlier.

To assess the importance of the effect of rising education levels on these estimates, we next present earnings regression estimates based on several years of CPS data. Tables 2 through 5 provide results for 1993, 1983, 1973, and 1963 earnings, respectively. The same-numbered column across years represents the same specification.

As a point of departure, we report a fairly standard specification for earnings in column 1.[5] We include sex, race, and a quartic (not so standard) specification for experience. The education control is years of schooling.[6] Table 2, which presents data for 1993, shows that women earn approximately 30 percent less than men on average, and blacks earn roughly 17 percent less than whites. Each term of the experience polynomial enters significantly, and the signs indicate an "increasing-at-a-decreasing-rate" experience profile. The years-of-education coefficient implies that each additional year of schooling adds 11 percent to earnings. However, this specification masks some important information regarding education and earnings, mainly because earnings tend to increase substantially with completion of certain levels of education (high school or college, for example).

The above specification cannot accurately address the size of the return to a high school or college education. To do so requires information on the highest degree achieved by an individual. Obtaining this information allows us to measure the return to specific levels of education. Column 2 of table 2 presents the results

■ **5** In the regressions that follow, we use sampling weights to make the CPS representative of the population.

■ **6** Beginning with the 1992 survey, the Bureau of Labor Statistics altered the wording and coding of the CPS to focus on degrees rather than on years of schooling. Thus, years are not available for partially fulfilled degrees. We use the means of years for workers falling into these categories in the 1991 survey as our best estimate for years in which a specific years-of-education figure is needed. This procedure is consistent with that of Frazis, Ports, and Stewart (1995), who review the effects of the altered procedure by comparing a sample in which both questions were asked.

TABLE 2

Earnings Regression Estimates, 1993

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	4.1594	5.4917	5.5018	5.4888	5.4745	5.4905	—
	(0.0164)	(0.0113)	(0.0112)	(0.0112)	(0.0113)	(0.0112)	—
Elementary school	—	—	−0.5506	−0.5527	—	−0.5265	−0.5393
	—	—	(0.0166)	(0.0167)	—	(0.0166)	—
7 to 12 years of education	—	—	−0.2723	−0.2724	—	—	—
	—	—	(0.0085)	(0.0085)	—	—	—
High school dropout	—	−0.3217	—	—	−0.1954	−0.2241	−0.2846
	—	(0.0079)	—	—	(0.0092)	(0.0092)	—
1 to 3 years of college	—	0.1918	0.1916	0.1922	0.2318	0.2080	0.1866
	—	(0.0057)	(0.0056)	(0.0057)	(0.0056)	(0.0056)	—
4 years of college to 1 year of graduate school	—	—	0.5193	—	0.5592	0.5355	0.5267
	—	—	(0.0065)	—	(0.0065)	(0.0065)	—
2 years of graduate school	—	—	0.7311	—	0.7728	0.7476	0.7244
	—	—	(0.0083)	—	(0.0084)	(0.0083)	—
4 years of college to 2 years of graduate school	—	0.5892	—	0.5894	—	—	—
	—	(0.0058)	—	(0.0058)	—	—	—
Years of education	0.1126	—	—	—	—	—	—
	(0.0009)	—	—	—	—	—	—
Years of experience	0.0815	0.0812	0.0799	0.0814	0.0771	0.0785	—
	(0.0022)	(0.0022)	(0.0022)	(0.0022)	(0.0023)	(0.0022)	—
Years of experience^2	−0.0031	−0.0031	−0.0030	−0.0031	−0.0028	−0.0029	—
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	—
Black	−0.1700	−0.1560	−0.1566	−0.1600	−0.1517	−0.1574	−0.1484
	(0.0071)	(0.0071)	(0.0071)	(0.0071)	(0.0072)	(0.0071)	—
Other nonwhite	−0.0597	−0.0793	−0.0745	−0.0741	−0.0905	−0.0770	−0.0710
	(0.0111)	(0.0111)	(0.0110)	(0.0111)	(0.0112)	(0.0111)	—
Female	−0.2904	−0.2873	−0.2869	−0.2884	−0.2784	−0.2841	−0.2993
	(0.0045)	(0.0045)	(0.0045)	(0.0045)	(0.0046)	(0.0045)	—
No. of observations	50,828	50,828	50,828	50,828	50,828	50,828	50,828
R^2	0.3464	0.3444	0.3546	0.3476	0.3362	0.3491	—

SOURCE: Authors' calculations based on the March 1994 Current Population Survey.

from a specification that includes dummy variables for the highest level of schooling achieved, with high school diploma being the omitted category (so that the interpretation of the education coefficients is relative to having completed only high school). The education coefficients clearly reveal the problem with the years-of-education specification. Although completing some college increases earnings somewhat (about 20 percent over those of a high school graduate), finishing college or graduate school boosts that figure to nearly 60 percent. The years-of-education specification essentially allows for a smooth line through the data and hence makes no distinction between completing the third and fourth year of college and obtaining a bachelor's degree, for example.

As mentioned above, because more individuals are enrolling in graduate school, including only "college or more" as a dummy variable will cause the results of earnings regressions to suffer from the same problem outlined above—the return will measure the average of college and post-college. As noted previously, in 1963 only 2.7 percent of those with a college degree went on to do post-graduate work, while in 1993 that figure was roughly 9 percent. The third column in table 2 presents results from a specification that allows for two additional dummy variables—one for elementary education only and one for post-graduate work. These statistics show a large gain to a post-

TABLE 3

Earnings Regression Estimates, 1983

Variable	(1)	(2)	(3)	(4)	(5)	(6)
Constant	4.6163	5.6574	5.6623	5.6536	5.6465	5.6503
	(0.0147)	(0.0102)	(0.0102)	(0.0102)	(0.0103)	(0.0102)
Elementary school	—	—	–0.4500	–0.4510	—	–0.4039
	—	—	(0.0147)	(0.0147)	—	(0.0147)
7 to 12 years of education	—	—	–0.2468	–0.2475	—	—
	—	—	(0.0067)	(0.0067)	—	—
High school dropout	—	–0.2736	—	—	–0.1688	–0.1905
	—	(0.0064)	—	—	(0.0075)	(0.0075)
1 to 3 years of college	—	0.1749	0.1753	0.1755	0.2121	0.1976
	—	(0.0059)	(0.0058)	(0.0058)	(0.0058)	(0.0058)
4 years of college to 1 year of graduate school	—	—	0.4110	—	0.4468	0.4328
	—	—	(0.0061)	—	(0.0061)	(0.0061)
2 years of graduate school	—	—	0.5715	—	0.6096	0.5944
	—	—	(0.0084)	—	(0.0085)	(0.0084)
4 years of college to 2 years of graduate school	—	0.4596	—	0.4602	—	—
	—	(0.0054)	—	(0.0054)	—	—
Years of education	0.0879	—	—	—	—	—
	(0.0008)	—	—	—	—	—
Years of experience	0.0824	0.0817	0.0807	0.0824	0.0765	0.0786
	(0.0023)	(0.0023)	(0.0023)	(0.0023)	(0.0023)	(0.0023)
Years of experience^2	–0.0035	–0.0034	–0.0034	–0.0035	–0.0031	–0.0032
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Black	–0.1662	–0.1648	–0.1629	–0.1639	–0.1737	–0.1676
	(0.0069)	(0.0070)	(0.0069)	(0.0069)	(0.0070)	(0.0070)
Other nonwhite	–0.0755	–0.0842	–0.0853	–0.0812	–0.0947	–0.0869
	(0.0136)	(0.0136)	(0.0135)	(0.0136)	(0.0137)	(0.0136)
Female	–0.3828	–0.3811	–0.3794	–0.3820	–0.3684	–0.3735
	(0.0043)	(0.0043)	(0.0043)	(0.0043)	(0.0044)	(0.0043)
No. of observations	50,445	50,445	50,445	50,445	50,445	50,445
R^2	0.3583	0.3562	0.3623	0.3585	0.3437	0.3534

SOURCE: Authors' calculations based on the March 1984 Current Population Survey.

graduate degree as compared to a four-year degree (approximately 20 percentage points). The measured return to a college education, however, declined about 12 percent (or about seven percentage points, from 0.589 to 0.519). This means that combining post-college graduates with those holding only a bachelor's degree leads to a substantial upward bias in the return to a college education.

Columns 4 to 6 in the tables reflect slight modifications of the education specification. For example, column 4 is similar to column 2, but includes dummy variables for elementary schooling and 7 to 12 years of education, while omitting the high school dropout category. Evidently, these changes make little difference in the return to college, post-college, race, or sex coefficients.

The results using the semiparametric experience specification are shown in the last column of table 2. Because economic theory provides no particular parametric form for the experience profile, we reran the above regression allowing that profile to be any smooth function. Estimates for the return to education and to the various demographic variables shown in table 2 were obtained using the semiparametric regression technique of Robinson (1988). This technique simultaneously solves for discrete, linear regression parameters and an arbitrary smooth-kernel regression of a continuous variable by finding the least-squares solution to this

TABLE 4

Earnings Regression Estimates, 1973

Variable	(1)	(2)	(3)	(4)	(5)	(6)
Constant	4.9667	5.8283	5.8264	5.8241	5.8000	5.8061
	(0.0155)	(0.0103)	(0.0103)	(0.0103)	(0.0105)	(0.0104)
Elementary school	—	—	−0.4063	−0.4068	—	−0.3361
	—	—	(0.0130)	(0.0130)	—	(0.0128)
7 to 12 years of education	—	—	−0.2012	−0.2015	—	—
	—	—	(0.0064)	(0.0064)	—	—
High school dropout	—	−0.2259	—	—	−0.0954	−0.1223
	—	(0.0062)	—	—	(0.0071)	(0.0071)
1 to 3 years of college	—	0.1468	0.1475	0.1475	0.2012	0.1838
	—	(0.0072)	(0.0072)	(0.0072)	(0.0071)	(0.0071)
4 years of college to 1 year of graduate school	—	—	0.3813	—	0.4315	0.4158
	—	—	(0.0077)	—	(0.0077)	(0.0077)
2 years of graduate school	—	—	0.4646	—	0.5187	0.5014
	—	—	(0.0117)	—	(0.0118)	(0.0117)
4 years of college to 2 years of graduate school	—	0.4025	—	0.4038	—	—
	—	(0.0069)	—	(0.0069)	—	—
Years of education	0.0729	—	—	—	—	—
	(0.0009)	—	—	—	—	—
Years of experience	0.0811	0.0805	0.0805	0.0810	0.0763	0.0778
	(0.0023)	(0.0023)	(0.0023)	(0.0023)	(0.0024)	(0.0023)
Years of experience^2	−0.0034	−0.0034	−0.0034	−0.0034	−0.0031	−0.0032
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Black	−0.1888	−0.2002	−0.1917	−0.1921	−0.2259	−0.2049
	(0.0079)	(0.0080)	(0.0079)	(0.0079)	(0.0080)	(0.0080)
Other nonwhite	−0.0941	−0.1134	−0.1099	−0.1076	−0.1172	−0.1086
	(0.0079)	(0.0203)	(0.0202)	(0.0202)	(0.0206)	(0.0204)
Female	−0.5119	−0.5049	−0.5058	−0.5072	−0.4898	−0.4969
	(0.0051)	(0.0051)	(0.0051)	(0.0051)	(0.0051)	(0.0051)
No. of observations	38,266	38,266	38,266	38,266	38,266	38,266
R^2	0.3837	0.3810	0.3857	0.3851	0.3632	0.3745

SOURCE: Authors' calculations based on the March 1974 Current Population Survey.

specification. Therefore, the parameters on the variables of interest (education, race, and sex) are conditional on the highly flexible experience profile of the nonparametric estimate.

The parameter estimates, although slightly different in actual magnitude, display almost the same pattern as the regression based on the quartic specification. The nonparametric experience profiles are similar to the column 3 estimates, confirming that the quartic specification does a reasonable job of controlling for experience. Therefore, for other years we omit column 7.

Misspecification of either experience or education may affect other variables, but for our specifications, these changes are quite small. For example, focusing on the coefficient on "black" across specifications, using just the years-of-education specification (column 1 of table 2), gives a value of −17 percent. However, allowing dummy variables for educational achievement and a nonparametric representation of experience (column 7 of table 2) increases the value on black to −14.8 percent. Therefore, misspecifying the way experience and/or education enters has consequences for the degree of race-based earnings inequality.

Because the educational attainment of the workforce has changed dramatically over time,

TABLE 5

Earnings Regression Estimates, 1963

Variable	(1)	(2)	(3)	(4)	(5)	(6)
Constant	5.0026	5.7369	5.7328	5.7328	5.6890	5.6972
	(0.0237)	(0.0183)	(0.0182)	(0.0182)	(0.0185)	(0.0184)
Elementary school	—	—	−0.3971	−0.3971	—	−0.2892
	—	—	(0.0155)	(0.0155)	—	(0.0149)
7 to 12 years of education	—	—	−0.1983	−0.1983	—	—
		—	(0.0086)	(0.0086)	—	—
High school dropout	—	−0.2214	—	—	−0.0426	−0.0751
	—	(0.0084)	—	—	(0.0092)	(0.0093)
1 to 3 years of college	—	0.1304	0.1303	0.1303	0.0228	0.1988
	—	(0.0122)	(0.0121)	(0.0121)	(0.0119)	(0.0119)
4 years of college to 1 year of graduate school	—	—	0.3059	—	0.3945	0.3718
	—	—	(0.0129)	—	(0.0128)	(0.0127)
2 years of graduate school	—	—	0.3095	—	0.4030	0.3786
	—	—	(0.0215)	—	(0.0217)	(0.0215)
4 years of college to 2 years of graduate school	—	0.3065	—	0.3068	—	—
	—	(0.0117)	—	(0.0116)	—	—
Years of education	0.0612	—	—	—	—	—
	(0.0012)	—	—	—	—	—
Years of experience	0.0596	0.0604	0.0606	0.0606	0.0555	0.0570
	(0.0038)	(0.0038)	(0.0038)	(0.0038)	(0.0039)	(0.0038)
Years of experience^2	−0.0022	−0.0023	−0.0023	−0.0023	−0.0020	−0.0021
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0003)
Black	−0.3219	−0.3517	−0.3314	−0.3314	−0.3915	−0.3544
	(0.0123)	(0.0123)	(0.0124)	(0.0124)	(0.0124)	(0.0125)
Other nonwhite	−0.1305	−0.1753	−0.1574	−0.1574	−0.1766	−0.1529
	(0.0383)	(0.0386)	(0.0384)	(0.0384)	(0.0393)	(0.0389)
Female	−0.4962	−0.4874	−0.4915	−0.4915	−0.4663	−0.4765
	(0.0077)	(0.0078)	(0.0078)	(0.0078)	(0.0079)	(0.0078)
No. of observations	18,960	18,960	18,960	18,960	18,960	18,960
R^2	0.3279	0.3182	0.3247	0.3247	0.2942	0.3080

SOURCE: Authors' calculations based on the March 1964 Current Population Survey.

we next examine specifications across years.[7] Earnings are deflated using the GNP price deflator for personal consumption. We omit the specification using semiparametric experience from the earlier years, since there is little difference between that specification and the one using a fourth-order polynomial in experience. Comparing column 1 across years shows that the return to education (measured by years of schooling) has been rising over time. In fact, compared to 1963, the return to an additional year of schooling has nearly doubled, from 6 percent in 1963 to 11 percent in 1993.

Comparing column 2 across years also shows a similar pattern for those possessing at least a college degree. Again, between 1963 and 1993 we see a near doubling of the return to a college education. The return to completing only one to three years of college did not change much. However, those who dropped out of high school fared much worse (compared to high school graduates) in 1993 than in 1963. In 1963, high school dropouts earned about 22 percent less than high school graduates; by 1993, they were earning about 32 percent less.

Comparisons using column 3 show that the gains to finishing at least two years of graduate school went from about 31 percent above a high school graduate's earnings to 73 percent.

■ **7** We chose 10-year intervals simply for convenience; the differences we mention may be slightly affected by business cycle conditions.

On the other hand, the return to a college degree (with up to one year of graduate school) rose from 31 to 52 percent.

Comparing columns 2 and 3 in 1963 and 1993 clearly shows that the bias has been growing over time. In 1963, combining college with post-graduate work led to a 31 percent gain in earnings relative to high school graduates. In column 3, the return to college grads and those with at least two years of graduate school was also about 31 percent more. That is, separating the various educational groups in 1963 led to virtually no difference.

The results for 1993 tell a much different story. The coefficient on the combination of college and graduate school shows a gain, compared to high school graduates, of about 59 percent. Separating the different educational groups, however, reveals that those with some post-graduate work earned 73 percent more than high school graduates, while individuals with only a bachelor's degree received roughly 52 percent more.

Finally, we turn to an examination of other estimates that have changed markedly over time. Specifically, we concentrate on the race and sex coefficients. In 1963, blacks were paid roughly one-third less than whites. By 1973, that gap had narrowed to about 20 percent, and by 1993, to about 16 percent.

The pattern for females' earnings is slightly different. In 1963, women earned about half as much as men, and that figure did not change much over the ensuing 10 years. By 1983, however, the male–female earnings differential had begun to fall, with women making about 38 percent less than men. The gap narrowed again over the next 10 years, and by 1993, women were earning about 29 percent less than men.

IV. Conclusion

The general features of individual earnings are robust to a wide variety of specifications; however, the specific point estimates are not. This paper investigates two areas where the parameterization of the earnings function can alter the estimates. In the specification of both education levels and years of experience, the simplest specification could lead to substantial misestimation of the underlying model that suggests little about the exact functional form.

Evidently, the return to a college education has been rising over time. However, part of this return is due to an increasing number of individuals pursuing post-graduate schooling, a fact not typically controlled for in the existing literature. Combining both college and post-college graduates into one category leads to an overestimate of the return to college of approximately 12 percent (seven percentage points). On the other side of the earnings inequality issue, the relative wages of high school dropouts have been boosted by the rising education levels of workers within this category.

An experience profile that allows for considerable flatness in later years, after a steep initial rise, is strongly supported by the data. The simple specification of potential experience and its square fails to allow earnings to reflect this pattern. Although we favor the estimates derived using Robinson's (1988) technique, there appears to be little difference between these estimates and those obtained using Murphy and Welch's (1990) quartic specification.

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