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Changes in the returns to education and college quality

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ABSTRACT

This paper estimates changes in the effects of educational attainment and college quality on three cohorts of students observed during the 1970s, 1980s, and 1990s. Consistent with most of the prior literature, I find that educational attainment and college quality raise earnings, and the magnitudes of these effects have increased over time. The new contributions of this paper are the following: (1) changes in these effects are disaggregated by sex, race, and parent's SES, and include estimates of effects on earnings, labor force participation, family formation, and civic participation; (2) evidence of larger increases in the effects of education on earnings and labor force participation for men, Blacks, and Hispanics; (3) declining effects of educational attainment on voter registration; and (4) increasing effects of college quality on delaying marriage and childbearing, particularly for males.

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1. Introduction

Over the past 35 years, there have been remarkable changes in the education of the U.S. population. From 1970 to 2005, the share of the adult population that had completed high school rose from 52% to 85%, while the share that had completed 4 or more years of college rose from 11% to 28%. The gender composition of college enrollment changed dramatically, with the female share of enrollment in all degree granting institutions rising from 41% in 1970 to 57% in 2005 (Snyder, Dillow, & Hoffman, 2007). At the same time, the U.S. economy has been revolutionized. Manufacturing as a share of all non-farm employment fell from 22% in 1970 to 11% in 2005, while the share in the Information, Financial Activities, Professional and Business Services, and the Education and Health Services industries – where much of the employment is skill-based and requires advanced education – increased from 23 to 34%. Thus, we have seen substantial increases in both the demand and the supply of college-educated labor. Given these contemporaneous shifts, the wage premium associated with college attendance could rise or fall—however, most evidence suggests

that increases in demand for college-educated labor has outpaced the increases in supply leading to a widening wage premium. Much less is known about the relationship between college quality and labor market outcomes, particularly about how this relationship has changed over time given the economy-wide changes in demand and supply of college-educated labor.

In general the literature finds positive effects for an additional year of education on earnings. In a summary of this literature, Card (1999) finds that typical estimates of the effect of an additional year of education on hourly earnings range from 5% to 11%. This education wage premium increased rapidly during the 1980s. Several scholars point to the importance of changes in relative demand and supply of college-educated workers.¹

These increases in returns to education are likely to have impacts on non-labor market outcomes. Based on the results from a collection of empirical studies conducted between 1963 and 1982, Haveman and Wolfe (1984) conclude that the non-market benefits of additional years of education may be substantial: "... the annual value of

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¹ See Bound and Johnson (1992), Katz and Murphy (1992), Grogger and Eide (1995), Autor, Katz, and Krueger (1998), and Card and Lemieux (2001).

incremental schooling reported in standard human capital estimates may capture only about one-half of the total value of an additional year of schooling” (p. 401). Thus, studying effects beyond the labor market is important.

The literature that examines the effects of college quality on enrollees generally finds positive effects on the likelihood of graduation² and on earnings.³ Attending an elite college has also been found to lead to a higher likelihood of graduate school attendance (Eide, Brewer, & Ehrenberg, 1998), lower divorce rates (Bowen & Bok, 1998), and better health (Ross & Mirowsky, 1999). Additionally, the wage premium for attending an elite private college relative to a less- or non-competitive public institution increased during the 1980s (Brewer, Eide, & Ehrenberg, 1999).

However, causality is a particular challenge for many of these studies due to endogenous selection on the part of both the student and the college. If there are unobserved characteristics that prompt students to apply to high-quality institutions and also directly affect outcomes, the omitted variable will bias estimates of the effect of college quality (Dale & Krueger, 2002). In Long (2008), I test the sensitivity of the estimated effects to various identification methods. I find positive effects of various labor market outcomes when estimated using an OLS specification, and only modest evidence suggesting positive selection bias in the OLS results. Further, I note that alternative methods rarely produce findings that are significantly different from the OLS estimates and these alternative methods have their own limitations which may invalidate their conclusions. OLS estimation may be sensible when appropriate control variables measuring student ability, ambition, and taste for education are available.

In this paper I extend the literature by focusing on a broad array of outcomes (including degree attainment, labor market participation, earnings, family formation, and civic participation) and by examining trends in the size of these effects. I also extend the literature by examining these trends by sex, race/ethnicity, and parent’s socioeconomic status.

Consistent with the prior literature, I find substantial wage premiums associated with additional years of education and that these returns to education increased in both the 1980s and the 1990s. I find that additional years of education increases labor force participation, but this effect appears to be declining for women and increasing for men, Blacks, and low-SES children. The positive effect of education on civic participation has declined. Additional years of education appears to lead to a delay in marriage and childbearing for young adults, and lowers the likelihood of divorce. The effect on marriage has been declining over time, while the effects on childbearing and divorce

are relatively unchanged. The increasing effect of years of education on earnings is mirrored by the increasing effects of overall college quality on hourly earnings. Likewise, the positive effect of college quality on the student’s likelihood of completing a bachelor’s degree has been increasing over time. I find no consistent evidence of a relationship between college quality and civic participation. Attending a better quality college leads to a delay in marriage and childbearing, and these effects have been increasing over time. Finally, I find a significant negative effect of college quality on divorce for students in the 1970s (consistent with Bowen & Bok, 1998), but this effect has evaporated for more recent cohorts.

2. Model

The following model is used to estimate the effect of years of education on various outcomes:

$$y_i = e_i\beta + \mathbf{X}_i\gamma + \mathbf{F}_i\phi + \mathbf{N}_i\omega + \varepsilon_i \quad (1)$$

where y is the outcome of interest, e is years of completed education, \mathbf{X} is a vector of student attributes, \mathbf{F} is a vector of parental family attributes, and \mathbf{N} is vector of neighborhood characteristics. The student, family, and neighborhood attributes consist of those characteristics that are anticipated to have direct effects on y (and perhaps have effects on e), and are constructed in a way to ensure comparability over the three cohorts. With regard to labor market outcomes, the theory underlying Eq. (1) is that, controlling for student, family, and neighborhood characteristics, an additional year of education either raises a student’s human capital or provides a signal to employers that the worker has higher ability, and this additional human capital/signal is rewarded in the labor market via higher wages (and may then prompt more labor force participation). Further it is anticipated that additional years of education will develop the student’s understanding of the world and thereby encourage civic participation. Finally, it is anticipated that additional years of education will lead to a delay in marriage and childbearing, and may increase the quality of marriages, leading to lower rates of divorce and higher household earnings.

Eq. (1) is estimated for each cohort separately and the estimates of β are tested for significant differences. The samples are split by gender, race/ethnicity, and parents’ socioeconomic status, to see whether returns to education have changed for subgroups of the population.

To test the effects of college quality, Eq. (1) is modified as follows:

$$y_i = q_i\beta + \mathbf{X}_i\gamma + \mathbf{F}_i\phi + \mathbf{N}_i\omega + \varepsilon_i \quad (2)$$

where q is a measure of college quality, and y includes the same labor market, civic participation, and family formation outcomes, as well as earning a bachelor’s degree. Eq. (2) is estimated for those who enrolled in a 4-year college within 2 years of their senior year of high school.

Eqs. (1) and (2) may suffer from an omitted variable bias if there is some omitted student characteristic that affects both y and e (or q). In general, there is a concern that positive, unobserved characteristics (e.g., “ambition”) may increase both y and e (or q), and thus lead to upwards bias in

² See Kane and Dickens (1996), Bowen and Bok (1998), Kane (1998), and Alon and Tienda (2005). Contrary evidence is found in Loury and Garman (1995) and Light and Strayer (2000).

³ See Wales (1973), James, Alsalam, and Conaty (1989), Loury and Garman (1995), Behrman, Rosenzweig, and Taubman (1996), Daniel et al. (1997), Bowen and Bok (1998), Hoxby (1998), Kane (1998), Brewer et al. (1999), Monks (2000), Hilmer (2002), Black and Smith (2004, 2006), Long (2008), and Hoekstra (2009).

the estimates. The data sets that are used contain a rich set of control variables, many of which proxy for the student's and parents' taste for education and the student's ambition and thereby minimize such bias. On the other hand, if there is measurement error in the computation of years of education or college quality, the estimated effects will be biased downwards. However, if the degree of such biases have not changed over time, the biases will not affect the test of equality of the coefficients. Thus, even if omitted variable bias still remains, the comparison of effects across cohorts could still be informative.

3. Data

Data are drawn from three longitudinal studies conducted by the Department of Education: National Longitudinal Study of the High School Class of 1972 (NLS) which followed high school seniors from 1972 to 1986; the sophomore cohort of High School and Beyond (HSB) which were followed from 1980 to 1992; and the National Education Longitudinal Study of 1988 (NELS) which followed eighth graders from 1988 to 2000. The three cohorts, containing between 10,000 and 13,000 observations, were in their senior year of high school in 1972, 1982, and 1992, respectively.

These datasets contain many strengths including: (1) being nationally representative; (2) large enough to allow for separate analyses by demographic group; (3) containing a rich set of covariates that are available which will help mitigate omitted variable bias; and (4) containing relatively consistent variable definitions across surveys. There are two weaknesses of these datasets for this analysis. First, the NLS survey followed high school seniors. Thus, it is not possible to evaluate the effects of additional years of high school before the senior year. To maintain comparability, HSB and NELS students who were never enrolled in the 12th grade are dropped from the analysis. Second, the ages of survey respondents were different in the final years of being surveyed. Since prior studies have generally found that the labor market returns to education increase with age,⁴ I discuss methods used to address the effect of students' ages on the estimated effects.

Total years of education are not included in any of the three surveys, rather the surveys include categorical measures of attainment. I convert these categorical measures into approximate years of completed education.⁵ College quality is an index based on the college's median freshman SAT/ACT test score, percent of the college's applicants who are rejected, tuition, full-time faculty to student ratio, percent of the faculty with a doctorate degree, and the college's Barron's index of selectivity.⁶ Data for these mea-

asures comes from the Barron's Profiles of American Colleges (1972, 1982, 1992). The index is normalized ($N(0, 1)$) within each year.

The three datasets contain a rich set of controls that can be incorporated into the analysis. The variables that I choose to include in the \mathbf{X} , \mathbf{F} , and \mathbf{N} vectors are those that likely affect both years of education/college quality and the outcomes of interest. These include the student's sex, race/ethnicity, high school grade point average, SAT/ACT test scores, class rank, participation in high school student government and athletics, and religion (Catholic, Protestant, other religion, or none); parents' income, socioeconomic status, and having a parent who attended college; attending a private high school and high school quality; living in a metropolitan statistical area; and the neighborhood's income per capita, unemployment rate, and average education level.

In the final year of interviewing, participants in the three cohorts were around 32, 28, and 26 years old, respectively. The NLS cohort is used to calibrate the age effects. Participants in the NLS were interviewed in both 1979 and 1986 (i.e., 7 and 14 years after high school). I estimate the effects at both points in time. I then use linear extrapolation between the two estimated coefficients to estimate the effect at 10 years after high school, which can then be conveniently compared to the estimated effects for the HSB cohort, who were interviewed 10 years after high school. The estimate of the effect for the NLS cohort after 10 years is the following:

$$\tilde{\beta}_{\text{NLS}10} = \frac{4}{7} \cdot \hat{\beta}_{\text{NLS}7} + \frac{3}{7} \cdot \hat{\beta}_{\text{NLS}14} \quad (3)$$

where $\hat{\beta}_{\text{NLS}7}$ indicates the estimated effect based on the 1979 interview, and $\hat{\beta}_{\text{NLS}14}$ indicates the estimated effect based on the 1986 interview. Note that this method assumes that the annual growth in the effect is constant.

The variance of $\tilde{\beta}_{\text{NLS}10}$ is the following⁷:

$$\begin{aligned} \text{Var}[\tilde{\beta}_{\text{NLS}10}] &= \frac{16}{49} \cdot \text{Var}[\hat{\beta}_{\text{NLS}7}] + \frac{9}{49} \cdot \text{Var}[\hat{\beta}_{\text{NLS}14}] \\ &\quad + \frac{24}{49} \cdot \text{Cov}[\hat{\beta}_{\text{NLS}7}, \hat{\beta}_{\text{NLS}14}] \end{aligned} \quad (4)$$

This variance is then used in computing the significance of the difference in $\tilde{\beta}_{\text{NLS}10}$ and $\hat{\beta}_{\text{HSB}10}$.⁸

Finally, for the NELS students who were interviewed 8 years after high school, I apply the linear extrapolation to the estimated effects to estimate these effects at 10 years after high school. I assume that the NELS cohort experiences the same annual change in the effect as observed for the NLS cohort. The estimate of the effect for the NELS

⁴ See Hanoch (1967), Wachtel (1975), and Deardon et al. (2002), for example.

⁵ The details on variable construction, as well as the full list of control variables and descriptive statistics, can be found in an on-line appendix at <http://faculty.washington.edu/marklong/EER-changes-in-returns.pdf>.

⁶ The index of college quality is constructed using the first principal component from a principal component analysis. The index produces a very sensible and stable ranking of the top colleges, with Brown, Cal Tech, Harvard, MIT, Princeton, and Yale being among the top-10 for each year.

⁷ Note that Eq. (4) does not assume zero covariance between the estimates of $\hat{\beta}_{\text{NLS}7}$ and $\hat{\beta}_{\text{NLS}14}$, since the estimates are derived from the same sample of students. The covariance of these coefficients is estimated using a bootstrapping procedure. I take a bootstrapped sample and estimate the coefficients, repeat the procedure 500 times, and take the covariance of the resulting estimates.

⁸ The method for computing the *t*-statistics for the differences in the effects across cohorts is available in the on-line appendix.

cohort after 10 years is the following:

$$\tilde{\beta}_{\text{NELS10}} = \hat{\beta}_{\text{NELS8}} + \frac{2}{7} \cdot (\hat{\beta}_{\text{NLS14}} - \hat{\beta}_{\text{NLS7}}) \quad (5)$$

The variance of $\tilde{\beta}_{\text{NELS10}}$ is the following:

$$\begin{aligned} \text{Var}[\tilde{\beta}_{\text{NELS10}}] &= \text{Var}[\hat{\beta}_{\text{NELS8}}] + \frac{4}{49} \cdot \text{Var}[\hat{\beta}_{\text{NLS14}} - \hat{\beta}_{\text{NLS7}}] \\ \text{Var}[\tilde{\beta}_{\text{NELS10}}] &= \text{Var}[\hat{\beta}_{\text{NELS8}}] + \frac{4}{49} \cdot (\text{Var}[\hat{\beta}_{\text{NLS14}}] \\ &\quad + \text{Var}[\hat{\beta}_{\text{NLS7}}] + 2 \cdot \text{Cov}[\hat{\beta}_{\text{NLS7}}, \hat{\beta}_{\text{NLS14}}]) \end{aligned} \quad (6)$$

This variance is then used in computing the significance of the difference in $\tilde{\beta}_{\text{NELS10}}$ and $\hat{\beta}_{\text{HSB10}}$. Finally, to compare the NLS and NELS estimates, the NLS estimates are extrapolated forward 1 year, and $\tilde{\beta}_{\text{NELS8}}$ is computed and compared to $\hat{\beta}_{\text{NELS8}}$, following similar procedures to those above.

Of course, the assumptions that the annual growth in the effect for the NLS cohort is constant across the 7 years, and that this annual growth in the effect has not changed across the 20 years between the NLS and NELS cohorts, are strong assumptions that are unlikely to be completely true. In the on-line appendix, using a parsimonious specification estimated using data from the Current Population Survey, I show that the linear extrapolation approach appears to be relatively sensible when estimating the effects of years of education on income. However, since I find increasing (labor market) returns to education across cohorts, it might be reasonable to expect the returns to education to rise faster for the NELS cohort than observed for the NLS cohort. If so, the resulting estimates of $\tilde{\beta}_{\text{NELS10}}$ may be underestimated. I now turn to discuss the results.

4. Results

Table 1 presents the estimated effects of years of education on various outcomes. For the NLS cohort interviewed in 1979 (7 years after high school), each additional year of education had a weakly significant *negative* effect on their 1978 log-annual earnings (−0.012). However, when interviewed in 1986 (14 years after high school), each year of education raised log-annual earnings by a significant 0.062. Assuming the annual increase in the effect of education on annual earnings is constant between these two suggests that the estimated effect would have been 0.020 if they had been interviewed in 1982 (10 years after high school). For the HSB cohort, log-annual earnings was increased by 0.040 for each additional year of education. Using the procedures outlined above, this 0.020 increase in the effect of education on log-annual earnings is significant. For the NELS cohort interviewed in 2000 (8 years after high school), each additional year of education raised their 1999 log-annual earnings by 0.047. This effect is not significantly higher than the estimated effect for the HSB cohort. However, using the growth in the effect for the NLS cohort, the estimated effect for the NELS cohort if they had been interviewed in 2002 would be 0.068, which is 0.029 larger than the effect for the HSB cohort. The difference between $\tilde{\beta}_{\text{NELS10}}$ and $\hat{\beta}_{\text{HSB10}}$ is significant.

In contrast, the effect of education on voter registration has diminished. For the NLS cohort, each additional year of

education raised the likelihood of being registered to vote by 3.5 percentage points (for a survey member with mean characteristics). This effect fell to 2.8 percentage points for the HSB cohort and 1.8 percentage points for the NELS cohort.

Additional years of education appear to lead to a delay in marriage and childbearing. For the NLS cohort, each additional year of education significantly lowered the likelihood of marriage by 6.4 percentage points when interviewed in 1979, and 2.5 percentage points in 1986. Since the effect is eroding over time, it likely indicates that years of education leads to postponement (rather than suppression) of marriage. Evaluated at 10-year post-high school, this marriage postponement effect fell significantly from −4.7 to −3.1 to −2.7 percentage points. For the NLS cohort, each additional year of education significantly lowers the likelihood of having a child by 9.5 percentage points when interviewed in 1979, and 5.1 percentage points in 1986. The childbearing postponement effect fell from −7.7 to −6.6 then rebounded to −8.8 percentage points. For all three cohorts, additional years of education lowered the likelihood of being currently divorced, and there has been no change in the size of this effect.

Table 2 shows the effects disaggregated by demographic group, and adds the following outcomes: log couple's annual earnings, log hourly earnings, and labor force participation. Men experienced a larger increasing effect of years of education on earnings than for women; evaluated at 10 years post-high school, the effects increased by 0.058 for men and by 0.024 log-points for women between the NLS and NELS cohorts. Blacks and Hispanics experienced greater increasing effects of years of education on log-annual earnings than whites; the effects increased 0.037 for whites, 0.098 for Blacks, and 0.119 log-points for Hispanics. When the sample is split by parent's socioeconomic status (bottom-25%, middle-50%, and top-25%), each SES-level experienced significant gains in the returns to education between the NLS and NELS cohorts. Thus, the effects of years of education on annual earnings are increasing for every demographic group, but particularly for men, Blacks, and Hispanics. The pattern of the effects of education on couple's annual earnings and own hourly earnings (which are unfortunately not recorded for the HSB cohort) are similar in general to those for own annual earnings.

More education raises the likelihood of labor force participation, and there has been no change in this effect over time. However, there is substantial heterogeneity across demographic groups. Between the NLS and NELS cohorts, the effect on labor force participation declined for women from 3.3 to 2.2 percentage points, and increased for men from −0.4 to 0.1 percentage points. The effect on labor force participation increased for Blacks (−0.1 to 1.7 percentage points) and low-SES children (0.9–3.1 percentage points). The changes for other groups were insignificant.

There were significant declines between the NLS and NELS cohorts in the effect of education on delaying marriage for women, whites, Blacks, and high-SES children. For women, the negative effect of years of education on the likelihood of marriage 10 years after high school declined significantly between each cohort, from −6.1 to −4.4 to −2.6 percentage points. Blacks also experienced a substan-

Table 1
Effect of years of education on annual earnings, civic participation, and family formation.

		Log-annual earnings		Registered to vote		Ever been married		Have children		Currently divorced	
		$\hat{\beta}_T$	$\hat{\beta}_{10}$ or $\hat{\beta}_{10}$	$\hat{\beta}_T$	$\hat{\beta}_{10}$ or $\hat{\beta}_{10}$	$\hat{\beta}_T$	$\hat{\beta}_{10}$ or $\hat{\beta}_{10}$	$\hat{\beta}_T$	$\hat{\beta}_{10}$ or $\hat{\beta}_{10}$	$\hat{\beta}_T$	$\hat{\beta}_{10}$ or $\hat{\beta}_{10}$
NLS Cohort	β_{NLS7} S.E. (β_{NLS7})	-0.012* (0.007)	0.020*** (0.005)	3.50*** (0.35%)	3.49*** 0.25%	-6.36*** (0.36%)	-4.72*** 0.25%	-9.54*** (0.39%)	-7.65*** 0.29%	-1.65*** (0.18%)	-1.56*** 0.15%
NLS Cohort	β_{NLS14} S.E. (β_{NLS14})	0.062*** (0.007)		3.46*** (0.35%)		-2.52*** (0.30%)		-5.13*** (0.41%)		-1.43*** (0.24%)	
HSB Cohort	β_{HSB10} S.E. (β_{HSB10})	0.040*** (0.007)	0.040*** (0.007)	2.84*** (0.40%)	2.84*** (0.40%)	-3.06*** (0.42%)	-3.06*** (0.42%)	-6.56*** (0.46%)	-6.56*** (0.46%)	-1.45*** (0.25%)	-1.45*** (0.25%)
NELS Cohort	β_{NELS8} S.E. (β_{NELS8})	0.047*** (0.009)	0.068*** (0.009)	1.84*** (0.47%)	1.83*** 0.48%	-3.83*** (0.61%)	-2.73*** 0.62%	-10.02*** (0.69%)	-8.76*** 0.71%	-1.38*** (0.26%)	-1.32*** 0.29%
	Test: $\beta_{NELS7} = \beta_{NELS14}$	0.0***		94.0%		0.0***		0.0**		46.8%	
	Test: $\beta_{NELS7} = \beta_{HSB10}$	0.0***		20.7%		0.0***		0.0*		53.7%	
	Test: $\beta_{NELS14} = \beta_{HSB10}$	2.4***		23.5%		29.8%		2.0**		95.1%	
	Test: $\beta_{NELS10} = \beta_{HSB10}$		1.9**		16.7%		0.1***		4.4**		72.8%
	Test: $\beta_{NELS7} = \beta_{NELS8}$	0.0***		0.4***		0.0***		54.6%		41.6%	
	Test: $\beta_{NELS14} = \beta_{NELS8}$	20.0%		0.5***		5*		0.5***		88.2%	
	Test: $\beta_{HSB10} = \beta_{NELS8}$	48.8%		9.9%		29.8%		0.0***		84.2%	
	Test: $\beta_{HSB10} = \beta_{NELS10}$		1.2***		10.4%		65.8%		0.9***		72.2%
	Test: $\beta_{NELS8} = \beta_{NELS10}$		0.0***		0.3***		0.4***		15.1%		45.6%

Each coefficient estimate comes from a separate regression. Regressions include controls for the variables listed in Appendix Table 1 under **X, F**, and **N** (see: <http://faculty.washington.edu/marklong/EER-changes-in-returns.pdf>). Effects for dichotomous dependent variables are estimated using probit regressions, and the displayed coefficients are the marginal effects for a student with mean characteristics. Full results are available from the author.

* Two-tailed significance at the 10% level.

** Two-tailed significance at the 5% level.

*** Two-tailed significance at the 1% level.

Table 2
Effects of years of education by demographic group.

		Number of obs.	Log-annual earnings	Log couple's annual earnings	Log hourly earnings (β_8)	Labor force participation	Registered to vote	Ever been married	Have children	Currently divorced
Overall	β_{NLS10}	12,881	0.020	0.024	1.011	1.11%	3.49%	-4.72%	-7.65%	-1.56%
	β_{HSB10}	9,951	0.040 +	0.038 +	0.063 NA, +	1.01% n	2.84% n	-3.06% +	-6.56% +	-1.45% n
	β_{NELS10}	11,259	0.068 +, +	0.063 +, +		1.19% n, n	1.83% n, -	-2.73% n, +	-8.76% -, n	-1.32% n, n
Female	β_{NLS10}	6,749	0.069	0.041	0.037	3.28% n	3.00% n	-6.08%	-10.00%	-1.82% n
	β_{HSB10}	5,307	0.059 n	0.045 n	0.045 n, n	2.72% n	3.33% n	-4.37% +	-8.95% n	-1.66% n, n
	β_{NELS10}	5,916	0.093 +, +	0.058 n, n		2.25% n, -	1.68%	-2.57% +, +	-11.01% -, n	-1.38% n, n
Male	β_{NLS10}	6,132	-0.022	0.008	-0.011	-0.37%	4.04%	-3.06%	-5.22%	-1.23% n
	β_{HSB10}	4,644	0.022 +	0.030 +		-0.36% n	2.36% -	-1.66% +	-3.98% +	-1.22% n
	β_{NELS10}	5,343	0.035 n, +	0.061 +, +		0.11% n, +	1.85% n, -	-2.90% n, n	-5.85% -, n	-1.15% n, n
White	β_{NLS10}	10,490	0.022	0.025	0.010	1.26% n	3.29%	-4.57%	-7.60%	-1.48% n
	β_{HSB10}	6,274	0.045 +	0.044 +		1.39% n	2.30% -	-2.94% +	-6.71% n	-1.32% n
	β_{NELS10}	7,819	0.059 n, +	0.053 n, +	0.058 NA, +	1.13% n, n	1.50% n, -	-2.59% n, +	-7.70% n, n	-1.25% n, n
Black	β_{NLS10}	1,431	0.009	0.004	0.023	-0.10%	3.81%	-6.28%	-8.27%	-2.84% +
	β_{HSB10}	1,191	0.041 n	-0.007 n		-0.43% n	3.06% n	-0.99% +	-4.20% +	-1.13% n, +
	β_{NELS10}	1,047	0.107 +, +	0.095 +, +	0.072 NA, +	1.74% +, +	2.28% n, n	-1.97% n, +	-8.56% -, n	-1.36% n, +
Hispanic	β_{NLS10}	620	-0.009	0.013	0.011	0.30%	3.83%	-4.31%	-6.58%	-1.23% n
	β_{HSB10}	2,036	0.021 n	0.053 n		-0.60% n	4.83% n	-4.39% n	-6.80% n	-2.26% n, n
	β_{NELS10}	1,466	0.109 +, +	0.088 n, +	0.080 NA, +	1.52% +, n	4.71% n, n	-4.82% n, n	-16.64%	-1.18% n, n
High-SES	β_{NLS10}	3,261	0.028	0.025	0.016	1.21%	2.89%	-3.89%	-5.19%	-0.90% n
	β_{HSB10}	2,353	0.047 n	0.024 n		1.61% n	2.27% n	-2.14% +	-5.86% n	-1.39% n
	β_{NELS10}	2,925	0.070 n, +	0.046 n, n	0.068 NA, +	1.11% n, n	0.65% n, -	-1.62% n, +	-3.04% +, +	-0.41% n, +
Mid-SES	β_{NLS10}	6,078	0.020	0.029	0.008	1.21%	3.37%	-4.63%	-8.48%	-1.55% n
	β_{HSB10}	5,070	0.040 +	0.045 n		0.96% n	2.72% n	-3.40% +	-6.99% +	-1.17% n
	β_{NELS10}	5,445	0.064 n, +	0.058 n, +	0.058 NA, +	0.86% n, n	1.44% n, -	-3.07% n, n	-10.03% -, n	-1.41% n, n
Low-SES	β_{NLS10}	3,542	0.016	0.022	0.014	0.87%	4.58%	-5.50%	-8.10%	-1.75% n
	β_{HSB10}	2,528	0.044 +	0.040 n		0.72% n	2.54% -	-2.76% +	-5.02% +	-1.50% n
	β_{NELS10}	2,889	0.073 n, +	0.104 +, +	0.062 NA, +	3.05% +, +	3.79% n, n	-3.83% n, n	-12.50%	-0.56% n, n

Effects that are significant at the 10% level are bolded. “+” (“-”) designates a significant increase (decrease) from the prior cohort at the 10% level. “n” indicates an insignificant change from the prior cohort. The “+”, “-”, or “n” listed second (after the comma) in the β_{NELS10} rows indicates the significance of the difference of β_{NLS10} and β_{NELS10} (these estimated coefficients, which are not shown, are available on request). Each coefficient estimate comes from a separate regression. Regressions include controls for the variables listed in Appendix Table 1 under X, F, and N. Effects for dichotomous dependent variables are estimated using probit regressions, and the displayed coefficients are the marginal effects for a student with mean characteristics. Couple's annual earnings is defined as the sum of own and spouse/partner's annual earnings. The estimates of the effects on couple's earnings are restricted to those who had a spouse or partner. Full results are available from the author.

Table 3
Effect of college quality index on bachelor's degree attainment, annual earnings, civic participation, and family formation.

	Bachelor's degree received		Log-annual earnings		Registered to vote		Ever been married		Have children		Currently divorced	
	$\hat{\beta}_T$	$\hat{\beta}_{10}$ or $\tilde{\beta}_{10}$	$\hat{\beta}_T$	$\hat{\beta}_{10}$ or $\tilde{\beta}_{10}$	$\hat{\beta}_T$	$\hat{\beta}_{10}$ or $\tilde{\beta}_{10}$	$\hat{\beta}_T$	$\hat{\beta}_{10}$ or $\tilde{\beta}_{10}$	$\hat{\beta}_T$	$\hat{\beta}_{10}$ or $\tilde{\beta}_{10}$	$\hat{\beta}_T$	$\hat{\beta}_{10}$ or $\tilde{\beta}_{10}$
NLS Cohort	β_{NLS7} S.E. (β_{NLS7})	5.41%*** (0.94%)	0.007 (0.020)	0.026* (0.014)	0.15% (0.020)	-0.18% 0.90%	-4.03%*** (1.06%)	-2.60%*** 0.73%	-3.91%*** (0.76%)	-2.72%*** 0.65%	-0.60%* (0.32%)	-0.66%*** 0.27%
NLS Cohort	β_{NLS14} S.E. (β_{NLS14})	4.40%*** (0.87%)	0.052*** (0.020)		-0.64% (0.73%)		-0.69% (0.94%)		-1.14% (1.16%)		-0.75% (0.47%)	
HSB Cohort	β_{HSB10} S.E. (β_{HSB10})	7.35%*** (1.33%)	0.046*** (0.017)	0.046*** (0.017)	1.96%* (1.33%)	1.96%* (1.33%)	-1.75% (1.33%)	-1.75% (1.31%)	-2.93%*** (1.21%)	-2.93%*** (1.21%)	-0.40% (0.52%)	-0.40% (0.52%)
NELS Cohort	β_{NELS8} S.E. (β_{NELS8})	8.49%*** (1.59%)	0.035* (0.021)	0.048** (0.022)	-1.63%* (0.92%)	-1.86%* 0.96%	-7.21%*** (1.43%)	-6.26%*** 1.47%	-6.71%*** (1.26%)	-5.92%*** 1.24%	0.28% (0.40%)	0.24% 0.42%
	Test: $\beta_{NLS7} = \beta_{NLS14}$	43.1%	11.1%		49.5%		1.87%**		4.5%**		79.3%	
	Test: $\beta_{NLS7} = \beta_{HSB10}$	23.3%	14.1%		21.2%		17.55%		49.4%		74.1%	
	Test: $\beta_{NLS14} = \beta_{HSB10}$	6.3%**	81.5%		5.4%		51.3%		28.5%		61.7%	
	Test: $\beta_{NLS10} = \beta_{HSB10}$			38.2%		9.5%*		57.1%		87.9%		65.1%
	Test: $\beta_{NLS7} = \beta_{NELS8}$	9.2%*	32.7%		16.4%		7.3%*		4.7%**		8.4%*	
	Test: $\beta_{NLS14} = \beta_{NELS8}$	2.3%**	56.6%		39.6%		0.0%***		0.1%***		9.5%*	
	Test: $\beta_{HSB10} = \beta_{NELS8}$	58.1%	70.2%		1.4%		0.5%***		2.6%**		30.0%	
	Test: $\beta_{HSB10} = \beta_{NELS10}$			92.8%		1.0%**		2.2%**		8.5%*		34.3%
	Test: $\beta_{NELS8} = \beta_{NELS10}$			42.1%		16.5%		3.1%**		1.9%**		6.5%**

Samples are restricted to those who enrolled in one of the 4-year colleges included in the Barron's Profiles of American Colleges within 2 years of after senior year in high school. Each coefficient estimate comes from a separate regression. Regressions include controls for the variables listed in Appendix Table 2 under **X**, **F**, and **N**. Effects for dichotomous dependent variables are estimated using probit regressions, and the displayed coefficients are the marginal effects for a student with mean characteristics. Full results are available from the author.

* Two-tailed significance at the 10% level.

** Two-tailed significance at the 5% level.

*** Two-tailed significance at the 1% level.

Table 4
Effect of college quality index by demographic group.

		Number of obs.	Bachelor's degree	Log-annual earnings	Log couple's annual earnings	Log hourly earnings (\$)	Labor force participation	Registered to vote	Ever been married	Have children	Currently divorced
Overall	β_{NLS10}	4103	4.97%	0.026	0.009	0.013	-0.84%	-0.18%	-2.60%	-2.72%	-0.66%
	β_{HSB10}	4125	7.35%	0.046	0.060	0.068	-0.92%	1.96%	-1.75%	-2.93%	-0.40%
	β_{NELS10}	4741	8.20%	0.048	0.046	0.068	-1.05%	-1.86%	-6.26%	-5.92%	0.24%
Female	β_{NLS10}	2020	5.22%	0.045	-0.001	0.018	0.45%	-0.06%	-2.59%	-3.62%	-0.04%
	β_{HSB10}	2193	5.95%	0.024	0.090	0.090	-1.47%	3.33%	-4.07%	-3.86%	-0.41%
	β_{NELS10}	2554	7.63%	0.018	0.039	0.057	-1.10%	-1.62%	-4.23%	-5.44%	0.63%
Male	β_{NLS10}	2083	4.73%	0.009	0.019	0.008	-1.47%	-0.50%	-2.58%	-1.83%	-0.48%
	β_{HSB10}	1932	8.52%	0.058	0.038	0.079	-0.44%	1.14%	0.44%	-2.31%	0.00%
	β_{NELS10}	2187	8.37%	0.080	0.054	0.079	-0.66%	-2.20%	-8.04%	-5.26%	0.04%
White	β_{NLS10}	3488	5.19%	0.021	0.005	0.013	-0.63%	-0.39%	-2.48%	-2.42%	-0.57%
	β_{HSB10}	2791	8.11%	0.043	0.063	0.052	-0.88%	1.19%	-1.90%	-4.13%	-0.30%
	β_{NELS10}	3475	6.38%	0.049	0.043	0.052	-0.71%	-2.05%	-6.55%	-4.87%	0.45%
Black, or native American	β_{NLS10}	545	3.67%	0.059	0.045	0.006	-0.72%	1.13%	-4.36%	-6.37%	-0.95%
	β_{HSB10}	1170	1.75%	0.075	0.070	0.079	-1.13%	3.75%	-0.09%	3.06%	-0.47%
	β_{NELS10}	805	11.54%	-0.010	0.022	0.079	-2.30%	0.76%	-5.29%	-11.96%	-1.24%
High-SES	β_{NLS10}	1919	3.71%	0.056	0.022	0.018	-0.11%	-0.92%	-2.13%	-1.01%	0.07%
	β_{HSB10}	1115	4.59%	0.028	0.030	0.046	-3.69%	1.46%	-1.12%	-1.89%	0.00%
	β_{NELS10}	2126	4.18%	0.077	0.102	0.046	-0.84%	-0.83%	-5.86%	-2.76%	0.02%
Mid-SES	β_{NLS10}	1629	5.26%	-0.005	-0.006	0.006	-0.81%	-0.82%	-2.71%	-1.64%	-0.95%
	β_{HSB10}	2347	8.33%	0.051	0.070	0.091	1.64%	1.90%	-2.31%	-3.90%	-0.27%
	β_{NELS10}	2089	9.78%	0.044	0.022	0.091	-1.12%	-3.47%	-6.90%	-11.11%	0.30%
Low-SES	β_{NLS10}	555	6.34%	0.037	0.026	0.009	-2.36%	2.20%	-4.36%	-4.16%	-0.38%
	β_{HSB10}	663	3.52%	0.168	0.119	0.048	-0.47%	-0.04%	-0.36%	1.61%	-0.10%
	β_{NELS10}	526	14.54%	-0.016	0.003	0.048	-1.01%	-2.67%	-0.72%	-5.85%	-0.30%

Samples are restricted to those who enrolled in one of the 4-year colleges included in the Barron's Profiles of American Colleges within 2 years of after senior year in high school. Effects that are significant at the 10% level are bolded. "+" ("−") designates a significant increase (decrease) from the prior cohort at the 10% level. "n" indicates an insignificant change from the prior cohort. The "+", "−", or "n" listed second (after the comma) in the β_{NELS10} rows indicates the significance of the difference of β_{NLS10} and β_{NELS10} (these estimated coefficients, which are not shown, are available on request). Each coefficient estimate comes from a separate regression. Regressions include controls for the variables listed in Appendix Table 2 under **X, F, and N**. Effects on dichotomous dependent variables are estimated using probit regressions, and displayed coefficients are the marginal effects for a student with mean characteristics. Full results are available from the author.

tially declining effect, falling from -6.3 to -1.0 to -2.0 percentage points. There were notably increasing negative effects of education on childbearing for Hispanics and low-SES children; between the NLS and NELS cohorts these effects increased from -6.6 to -16.4 percentage points for Hispanics; and -8.1 to -12.5 percentage points for low-SES children. The effects of years of education on the likelihood of being divorced (at age ~ 32) are negative for all of the demographic groups. In general, the sizes of these effects have not changed except for Blacks, which saw a significant decline between the NLS and NELS cohorts.

Table 3 presents the estimated effects of the index of college quality on bachelor's degree attainment and other outcomes. Evaluated at 10 years post-high school, a one standard deviation increase in college quality raised the likelihood of earning a bachelor's degree by 5.0, 7.4, and 8.5 percentage points for each cohort, respectively, and the difference between the NLS and NELS cohorts is weakly significant. Likewise, attending a higher quality college produced a positive effect on annual earnings for each cohort. The effect of a one standard deviation increase in college quality on log-annual earnings increased (insignificantly) from 0.026 to 0.046 to 0.048 points.

College quality had an insignificant effect on voter registration for the NLS cohort, but raised the likelihood of registration for the HSB cohort, and *lowered* the likelihood for the NELS cohort.

Enrolling in a higher quality college appears to lead to a delay in marriage and childbearing. For the NLS cohort, a one standard deviation increase in college quality significantly lowers the likelihood of being married (having a child) by 4.0 (3.9) percentage points when interviewed in 1979, and 0.7 (1.1) percentage points in 1986. Evaluated at 10 years post-high school, the postponement effects on marriage fell from -2.6 to -1.7 then increased to -6.3 percentage points, while the postponement effect on childbirth increased from -2.7 to -2.9 to -5.9 percentage points. The effect of college quality on divorce was negative and significant for the NLS cohort, but this effect disappeared for later cohorts.

Table 4 disaggregates these results by demographic group. The increasing effect of college quality on bachelor's degree attainment was experienced by every demographic group, and these increases were significant for low-SES children and Blacks, Hispanics, and Native Americans—groups who have traditionally been underrepresented in colleges.

Males were the only demographic group to experience an increasing effect on annual earnings, with the effect rising from 0.009 to 0.080 log-points. The effect on females' annual earnings insignificantly declined from 0.045 to 0.018 log-points. For Blacks, Hispanics, and Native Americans, the estimated effects on log-annual earnings increased from 0.059 to 0.075, then fell precipitously to an insignificant -0.010 —despite the increasing effect of college quality on these students' likelihood of earning a bachelor's degree. These results are, however, somewhat sensitive to the inclusion of individuals who are still enrolled in college at the time of the interview. Excluding these individuals, the effect of a one standard deviation increase in college quality on log-annual earnings rises from 0.024 to

0.069 to 0.071 for males; and 0.026 to 0.058 to 0.052 for females; but falls from 0.079 to 0.060 to 0.024 for underrepresented minorities. The effect of college quality on labor force participation has been negative and unchanged. However, excluding those who are currently enrolled in college, there is no effect on labor force participation—suggesting that the decreased labor force participation reflects increased graduate school attendance.

Every demographic group experienced a decline in the effect of college quality on voter registration between the HSB and NELS cohorts, and these declines were significant for females, whites, and mid-SES children. The effect of college quality on delaying marriage increased more for men (-2.6 to -8.0 percentage points) than for women (-2.6 to -4.2) between the NLS and NELS cohorts. The effects for whites (-2.5 to -6.6) and children of high-SES parents (-2.1 to -5.9) significantly increased, while there were insignificant changes for other groups. Likewise, the effect of college quality on delaying childbirth significantly increased for men (-1.8 to -5.3), but increased insignificantly for women (-3.6 to -5.4). Whites (-2.4 to -4.9), high-SES (-1.0 to -2.8) and mid-SES children (-1.6 to -11.1) experienced significantly increasing effects on childbearing. Underrepresented minorities were the only subgroup to experience a significant effect of college quality on divorce in the NELS cohort (-1.2 percentage points).

In summary, attending a higher quality college appears to increase the likelihood of earning a bachelor's degree; increases hourly, annual, and household earnings; and delays (or perhaps suppresses) the likelihood of marriage and childbearing. Moreover, the effect of college quality on degree attainment, hourly earnings, marriage, and childbearing has been increasing. The increasing effects are largest for men, whose share of college enrollment declined during this period.

5. Conclusion

Given the tremendous changes in the U.S. economy and education system in the latter third of the 20th century, it is fundamentally important to understand how these changes affected the returns to education and college quality. Using longitudinal data from three cohorts of students who were followed in the 1970s, 1980s, and 1990s, this paper finds increasing labor market returns to both years of education and college quality. For annual earnings, the increases in returns to years of education were greatest for men, Blacks, and Hispanics. Years of education was also found to increase voter registration, lead to delays in marriage and childbearing, and reduce rates of divorce. The effect of years of education on marriage delay has declined overall, and particularly for women, but it remains significant. Controlling for other variables, attending a higher quality college raises the likelihood of earning a bachelor's degree, raises hourly and annual earnings, and leads to a delay in marriage and childbearing. These effects of college quality have been increasing over time. Policymakers must become even more acutely aware of the importance of access to high-quality higher education given the apparent demands of the economy for high-skilled workers and the non-market consequences of educational quality.

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