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Extending the Race between Education and Technology

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Abstract

The race between education and technology provides a canonical framework that does an excellent job of explaining US wage structure changes across the twentieth century. The framework involves secular increases in the demand for more-educated workers from skill-biased technological change, combined with variations in the supply of skills from changes in educational access. We expand the analysis backwards and forwards. The framework helps explain rising skill differentials in the nineteenth and twenty-first centuries, but needs to be augmented to illuminate the recent convexification of education returns and implied slowdown in the growth of the relative demand for college workers. Increased educational wage differentials explain 75 percent of the rise of U.S. wage inequality from 1980 to 2000 as compared to 38 percent for 2000 to 2017.

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A great economic divide has emerged between college-educated workers and those with less than a college degree. Ever since 1980, educational wage differentials have greatly expanded, and soaring income inequality has deeply marked the US economy (Autor 2019). But that wasn't the way it always was in America.

The mid-twentieth century saw broadly-shared prosperity, little change in wage inequality, and a relatively stable college wage premium. And the first half of the twentieth century, particularly the 1940s, saw actual declines in inequality and reductions in educational wage differentials. High school graduates in the early twentieth century were an elite group. But by 1940, the median youth had become a high school graduate. College going was next to take off. But, at some point, educational advances slowed.

Educational wage gains and overall wage and income inequality have closely followed changes in educational attainment against a backdrop of increased relative demand for more-educated workers from skill-biased technological change (SBTC). The implicit framework is one of a *race between education and technology* (RBET). The notion was first expounded by Jan Tinbergen (1974) and was later built on and applied to the US case by Katz and Murphy (1992), Goldin and Katz (2008), and Autor (2014), among others.

The RBET framework, according to Goldin and Katz (2008), neatly explains changes in US educational wage differentials across the twentieth century. The idea is that there is secular growth in the demand for more-educated workers from SBTC at the same time there is rapid, but variable, growth of the relative supply of more-educated workers. An acceleration in relative supply growth from the high school movement reduced educational wage differentials in the first-half of the twentieth century. Fast educational growth kept educational wage differential in check during the mid-twentieth century. But from 1980 to 2005, a slowdown in relative education supply growth contributed to a soaring college wage premium. That's the saga of educational wage differentials from the 1890s to 2005.

But there's more to US history. What occurred in the most recent 15 years and what happened during the industrially-revolutionary nineteenth century? We extend the race between education and technology for the last 200 years to assess its strengths and limitations.

I. Long-run Changes in US Wage Differentials and Educational Attainment

We have undertaken the Herculean task of mapping out wage differentials in the US from 1825 to 2017. Figure 1 plots the evolution of these wage differentials on as consistent a basis as is possible.

We combine data from the Iowa State Census of 1915, the first representative micro-sample with educational attainment and earnings, with more traditional US Census and March Current Population Survey (CPS) micro-samples. To expand the series before 1914, we use occupational wage differentials and compare the earnings of those doing clerical work (a typical high school position) to the earnings of those doing production work (more typical of the less educated). For the earliest period shown, 1825 to 1875, data on clerical and production workers are obtained from civilian hires of the US military (Katz and Margo 2014; Margo 2000). For 1890 to 1959, various series on the wage of clerks to production workers are used (Goldin and Katz 2008).

The long-term series on occupational wage differentials show rising (high school) education wage gaps across the nineteenth and early twentieth centuries suggesting increased demand for more-educated workers with the emergence of large-scale enterprises but modest supply growth due to a lack of access to high school for most youth. White-collar workers were a non-competing group through the early twentieth century (Goldin and Katz 2008). Rising educational wage differentials characterized the period from 1820s to 1914, not unlike that in more recent history.

Then the high school movement, starting around 1910, produced a large decline in the high school wage premium and earnings gap between clerical and production workers from 1914 to 1960. The college wage premium also narrowed substantially through two World Wars rom 1914 to 1950. But then, in a real roller coaster ride, the college wage premium rebounded in the 1950s and 1960s before narrowing in the 1970s, and then greatly increasing post-1980. The college wage premium today exceeds it high level of 1914 as do some measures of U.S. top-end economic inequality (Piketty, Saez, and Zucman 2018).

Interestingly, the long-run increase in educational wage differentials, especially the higher college wage premium today than a century ago, have occurred despite large increases in the educational attainment of the US labor force. These large educational increases are illustrated in Figure 2, which gives the schooling attainment of each US birth cohort (1876 to 1987), measured at age 30.

The achievement of mass secondary schooling in the first part of the twentieth century and the development of a flexible and multi-faceted system of higher education in the US led to enormous increases in years of education (Goldin and Katz 2008). Educational attainment rose rapidly for cohorts born between 1876 and 1951. Mean years of schooling increased by 5.9 years (from 7.3 years to 13.2 years), or by 0.79 years per decade. Each successive generation of Americans had two more years of schooling than their parents.

Then the series hit a plateau, with educational attainment barely changing for cohorts born from 1951 to 1966. It began to rise again but at a slower pace than previously. Educational attainment for the 1951 to 1987 birth cohorts rose by 1.1 years up to a level of 14.3 years for the 1987 birth cohort, a rate of increase of just 0.29 years per decade. A child born in 1987 had 0.88 more years of schooling than his or her parents born in 1962.

How much did this slowdown in the growth of educational attainment across cohorts contribute to the rise in the college wage premium since the late 1970s?

II. The Race between Education and Technology, 1914 to 2017

We follow Katz and Murphy (1992), Goldin and Katz (2008), and Autor, Katz, and Kearney (2008) in modeling changes in educational wage differentials using the conceptual framework of a race between the supply of skills (driven by changes in the educational attainment of the work force) and the demand for skills (driven by skill-biased technological change). We apply the approach to understand the evolution of the college wage premium from 1914 to 2017.

Our framework postulates a CES production function for aggregate output Q with two factors, skilled workers (S) and unskilled workers (U), who perform imperfectly substitutable tasks:

$$Q_t = [\alpha_t (a_t L_{S_t})^{\rho} + (1-\alpha_t)(b_t L_{U_t})^{\rho}]^{\frac{1}{\rho}} \qquad (1)$$

where L_{S_t} and L_{U_t} are the quantities of skilled labor and unskilled labor employed in period t, a_t and b_t represent skilled and unskilled labor augmenting technological change, α_t is a time-varying technology parameter indexing the share of work activities allocated to skilled labor. The production function parameter ρ is related to σ_{SU}, the aggregate elasticity of substitution between skilled and unskilled labor, such that $\sigma_{SU} = \frac{1}{1-\rho}$. Skill-neutral technological improvements raise a_t and b_t by the same proportion. Increases in (a_t/b_t) or in α_t both represent skill-biased technological change.[1] We focus on the college and high school divide so that skilled workers (S) are "college equivalents" (college graduates plus half of those with some college) and unskilled workers (U) are "high school equivalents" (those with 12 or fewer years of schooling and half of those with some college).

Under the assumption that college and high school equivalents are paid their marginal products, we can use eq. (1) to solve for the ratio of the marginal products of the

[1] Increases in (a_t/b_t) raise the relative demand for college workers when college and non-college workers are gross complements (σ_{SU}> 1), an assumption supported by our estimates here and many others in the literature. Increases in α_t always favor college workers.

two skill groups yielding a relationship between relative wages and relative skill supplies in t given by:

$$ln\left(\frac{w_{S_t}}{w_{U_t}}\right) = \frac{1}{\sigma_{SU}}\left[D_t - ln\left(\frac{L_{S_t}}{L_{U_t}}\right)\right] \tag{2}$$

where D_t, measured in log quantity units, depends on the skill-biased technological change parameters and indexes relative demand shifts favoring college equivalents.[2] The terms in brackets in eq. (2) show how the evolution of the college wage premium depends on a race between the relative demand for and supply of skills. The aggregate elasticity of substitution between college and high school equivalents (σ_{SU}), which reflects both production function technical substitution possibilities as well as consumer substitution possibilities between higher and less skilled goods and services, determines how much changes in skill supplies affect the college wage premium.

How important are supply and demand shifts for the evolution of the college wage premium since 1914, as shown in Figure 1? We estimate eq. (2) for the US college wage premium on the relative supply of college equivalents to high school equivalents for 1914 to 2017 with demand shifts given by smooth time trends and, in some specifications, an allowance for institutional wage-setting in the 1940s.[3]

The core findings are of a substantial positive secular trend in the relative demand for college workers and a strong negative impact of increases in the relative supply of college workers on the college wage premium. A 10 percent increase in the relative supply of college equivalents typically reduces the college wage premium by around 6 percent. The implication is that σ_{SU} is approximately 1.62 (using the estimate in col. 2 of Table A1), similar to other estimates in the literature, typically in the 1 to 2.5 range. Figure A1 plots the actual college wage premium and the predicted college wage premium using the estimates from col. 2 of Table A1.

Figure A1 reveals that a model with smooth secular relative demand trends favoring college workers, together with fluctuations in relative supply, does a pretty good job fitting the long-run evolution of the college wage premium. There are some exceptions, to be sure, to this stark representation. These include the large decline in the 1940s (likely driven by strong unions, tight labor markets, and government wage pressures during World War II), the continued decline in the late 1970s (likely due to strong union wage gains and

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[2] Note that $D_t = \sigma_{SU}\ [\ln(\alpha_t/[1-\alpha_t])] + (\sigma_{SU}-1)\ln(a_t/b_t)$.

[3] Appendix Table A1 presents results that extend to estimates in Goldin and Katz (2008, table 8.2) up to 2017.

minimum wage increases during the late 1970s), and the sharp rise in the early 1980s. But, by and large, the RBET framework does an awfully good job.

But the model's results (see Table A1) divulge a puzzling slowdown in the trend demand growth for college equivalents starting in the early 1990s. Rapid and disruptive technological change from computerization, robots, and artificial intelligence is not to be found—though the impact of these technologies may not be well-captured by this two-factor setup. The large rise in the college wage premium since 1980 is driven more by slower relative supply growth rather than by an acceleration in skill-biased technological change, or some other demand-side factor. A further comparison of the two periods, 1979 to 2017 and 1939 to 1979, illustrates the point (see Table A2).

The log college wage premium increased by 0.274 from 1979 to 2017 (from 0.4 to 0.674, or by 0.072 per decade). Compare that to the change from 1939 to 1979, when the premium *declined* by 0.088 (by 0.022 per decade). The rate of growth of the log relative supply of college equivalents was 0.31 per decade (or 3.1 percent per annum) from 1939 to 1979. But it decreased to 0.213 per decade (2.13 percent per annum) from 1979 to 2017.

The slowdown in relative supply growth accounts for 62 percent (0.058) of the 0.094 per decade increase in the growth rate of the college wage premium post-1979 relative to 1939 to 1979, under the assumption that σ_{SU} = 1.62. The implied acceleration in the growth of log relative demand for college equivalents of 0.058 per decade explains 38 percent (0.036) of the surge in the college wage premium after 1970, as compared with the pattern of modest decline in the mid-twentieth century.

A key question is why the secular trend terms in the estimated version of eq. (2) in Table A1 should be interpreted as reflecting relative demand shifts favoring college graduates from skill-biased technical change. For example, the implied faster relative demand growth post-1979 as compared with 1939 to 1979 could partially reflect institutional factors omitted from the framework, such as stronger unions, minimum wages, and egalitarian wage norms (e.g., the Treaty of Detroit).

But, in the late twentieth century these eroded with declining union density, a decreased real minimum wage, more market-based wage setting, and the use of domestic and international outsourcing, especially for non-college jobs. But much evidence does favor an important role for skill-biased technological change in the trend terms. Large within-industry and within-firm shifts to more educated workers in the face of rising educational wage differentials strongly suggests skill-biased technical change (Katz and Murphy 1992).

Case studies also document that new technologies have increased relative demand for more educated workers across diverse sectors such as banking (Autor, Levy, and Murnane 2002) and valve manufacturing (Bartel, Ichniowski, and Shaw 2007). Recent quasi-experimental studies further show that increased access to broadband (Akerman, Gaarder, and Mogstad 2015) and tax incentives to invest in information technology (Gaggle and Wright 2017) have shifted the skill mix toward college workers.

III. Educational Wage Differentials and Rising Wage Inequality since 1980

How much of the overall rise in wage inequality since 1980 can be attributed to the large increase in educational wage differentials? We follow Goldin and Katz (2007) and provide an intuitive answer as follows using data from the 1979 to 2018 CPS Merged Outgoing Rotation Groups (MORG).

We first estimate modified cross-section Mincerian human capital earnings regressions with log hourly wages as the dependent variable. We run it on a linear spline in years of schooling (with break points after 12 and 16 years), a quartic in estimated labor market experience, race, region, gender and year dummies, and interactions of gender and the experience quartic. The linear spline in education allows the "returns" to an additional year of schooling to differ for K-12, college, and post-BA schooling. The equation is estimated for 1980 (1979 to 1981 pooled), 2000 (1999 to 2001), and 2017 (2016 to 2018).

We examine the role of changing education returns from 1980 to 2017 by first imposing the 2017 returns to schooling on 1980, thereby adjusting individual wages in 1980. We then compare the distributions of actual and adjusted wages in 1980 to determine what wage inequality would have been with education returns at 2017 levels.[4] Wages in 2017 are analogously adjusted by imposing the 1980 education returns. The average of the results of the two simulations is then used. We repeat this approach for 1980 to 2000 and for 2000 to 2017.[5]

Our estimates of the earnings regressions for 1980, 2000, and 2017 imply that the returns to post-secondary schooling greatly increased to 2017 and simultaneously convexified. Returns to a year of K-12 schooling show little change since 1980. But returns to a year of college rose by 6.5 log points, from 0.076 in 1980 to 0.126 in 2000 to 0.141 in

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[4] We adjust 1980 wages to incorporate 2017 education returns by adding to each individual's wage in 1980 the sum of the product of that individual's years of schooling in each category (K-12, college, and post-college) and the difference between the estimated returns to schooling in 2017 and 1980 for that schooling category.

[5] Regressions and simulations are summarized in on-line Appendix Table A3.

2107. The returns to year of post-college (graduate and professional) rose by a whopping 10.9 log points, from 0.067 in 1980 to 0.131 in 2000 and to 0.176 in 2017.

Our simulations imply that the increase in schooling returns (from the rise in returns to post-secondary schooling) increased the variance of log hourly wages by 0.070 across from 1980 to 2017. Thus, 57 percent of the increase in variance (of 0.123, from 0.250 in 1980 to 0.373 in 2017) can be accounted for by increased returns to schooling. The rise in returns to post-secondary schooling similarly accounts for 57 percent of the increase in the 90-10 log hourly wage differential of 0.305 over the full period.

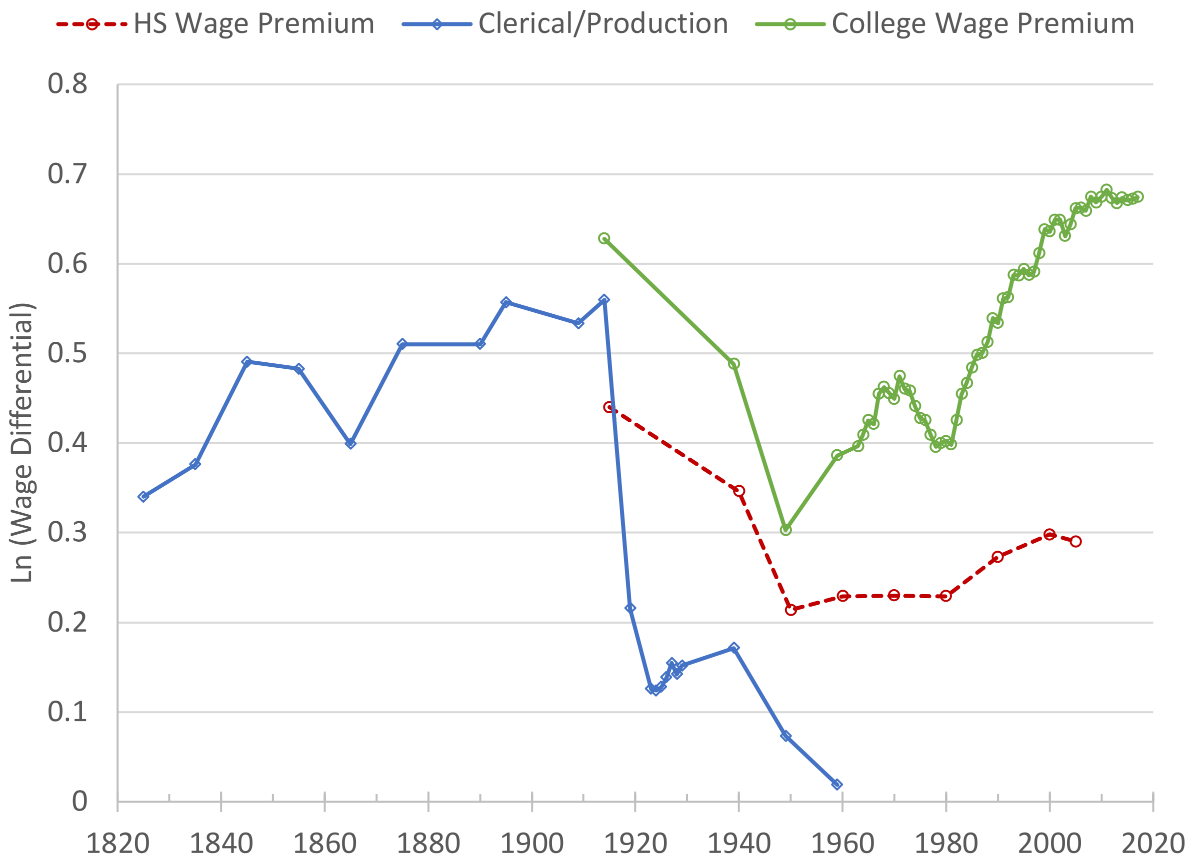
Wage inequality increased at about the same rate from 1980 to 2000 as from 2000 to 2017. The variance of log hourly wages increased by 0.065 from 1980 to 2000 and by 0.058 from 2000 to 2017. But the college wage premium increased much more rapidly in the first period than in the second. The rise in the returns to college education explains a far larger share of the increased log hourly wage variance from 1980 to 2000 than it does from 2000 to 2017, accounting for 75 percent in the first period, but just 38 percent more recently.

The canonical two-skill model of the race between education and technology explains the lion's share of the enormous increase in wage inequality from 1980 to 2000, when the slowdown in the growth of the relative supply of college workers produced a sharp rise in the college wage premium.

But most of the recent rise in wage inequality has occurred *within*, rather than *between*, education groups. In fact, the largest part of increased wage variance in the twenty-first century comes from rising inequality among college graduates. There is almost no change in wage inequality for non-college workers since 2000. Such a pattern is consistent with the continuing, rapid rise of the 90-50 wage differential and soaring top-end inequality, combined with stability in the 50-10 wage differential in the 2000s.

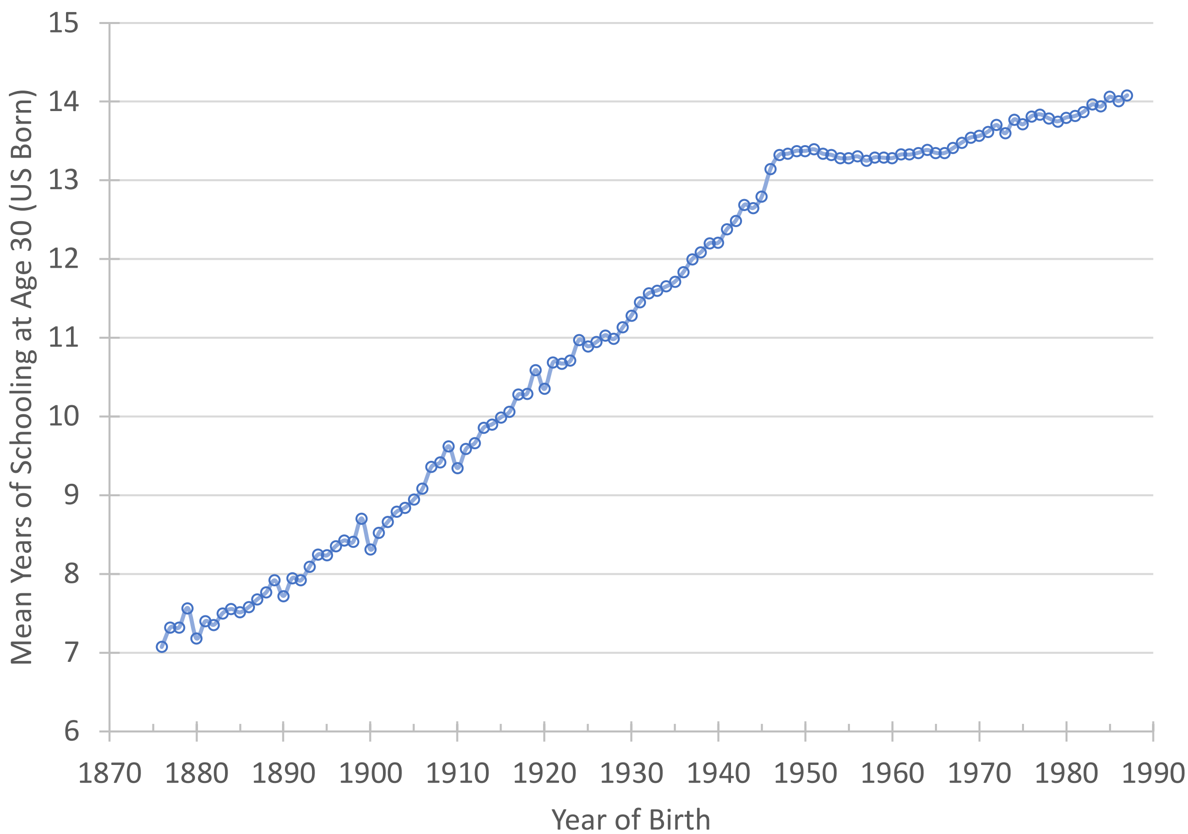
Comprehending rising wage inequality in the 2000s requires a better understanding of growing wage inequality among college graduates, the rise in the return to post-BA education, and stagnant earnings of middle-wage workers (the upper half of non-college and lower half of college workers). The RBET framework remains relevant in the twenty-first century, but needs some tweaks.

Figure 1: Educational and Occupational Wage Differentials: 1825 to 2017



Notes and Sources: Clerical/production worker series for 1825 to 1875 is based on Katz and Margo (2014, table 1.5), and that for 1890 to 1959 is from Goldin and Katz (2008, table 2.2). High school wage premium series is from Goldin and Katz (2008, table D.1). College wage premium series from Goldin and Katz (2008, table 8.2) updated to 2017. See the on-line appendix for details.

Figure 2: Mean Years of Schooling at Age 30 for the U.S. Born, 1876 to 1987 Birth Cohorts



Sources and Notes: US Census IPUMS data from 1940 to 2000 and CPS MORG data from 2005 to 2018. The figure updates Goldin and Katz (2007, figure 7). See the on-line appendix for details.

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On-line Appendix to

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Table A1: Determinants of the College Wage Premium: 1914 to 2017

	(1)	(2)	(3)	(4)
(College/high school) supply	-0.592	-0.619	-0.640	-0.651
	(0.070)	(0.077)	(0.057)	(0.071)
(College/high school) supply × post-1949				0.0111
				(0.0414)
Time	0.00472	0.0102	0.0106	0.0111
	(0.00182)	(0.00205)	(0.0015)	(0.0026)
Time × post-1949	0.0197			
	(0.0011)			
Time × post-1959		0.0161	0.0160	0.0154
		(0.0010)	(0.0008)	(0.0022)
Time × post-1992	-0.00769	-0.00971	-0.00938	-0.00940
	(0.00135)	(0.00156)	(0.00117)	(0.00118)
1949 Dummy			-0.136	-0.143
			(0.021)	(0.035)
Constant	-0.592	-0.694	-0.717	-0.742
	(0.148)	(0.163)	(0.122)	(0.156)
R^2	0.953	0.945	0.970	0.970
Number of observations	59	59	59	59

Sources and Notes: Each column is an OLS regression of the college wage premium on the indicated variables using a sample covering the years 1914, 1939, 1949, 1959, and 1963 to 2017. Standard errors are given in parentheses below the coefficients. The college wage premium is a fixed weighted average of the estimated college (exactly 16 years of schooling) and post-college (17+ years of schooling) wage differential relative to high school graduates (those with exactly 12 years of schooling). (College/high school) supply is the log supply of college equivalents to high school equivalents both measured in efficiency units. "Time" is measured as years since 1914. The samples used include workers from 16 to 64 years old. The data for 1963 to 2017 are from the 1964 to 2018 March CPS samples. The college wage premium and relative supplies in efficiency units for 1963 to 2017 use the same data processing steps and sample selection rules as those described in the data appendix to Autor, Katz, and Kearney (2008). The college wage premium for 1963 to 2017 uses the log weekly earnings of full-time, full-year workers. The college wage premium series is the same as plotted in Figure 1. The observations for 1914, 1939, 1949, and 1959 append the changes in the college wage premium series from 1915 to 1970 (actually 1914 to 1969) plotted in Figure 8.1 of Goldin and Katz (2008) to the 1969 data point from the March Current Population Survey (CPS) series. The log relative supply observations for 1914 to 1959 similarly append changes in the relative supply of college equivalents from 1914 to 1939 for Iowa and for the United States from 1939 to 1949, 1949 to 1959, and 1959 to 1969 from the Census Integrated Public Use Micro-data samples (IPUMS) using the efficiency-units measurement approach of Tables 8.5 and 8.6 of Goldin and Katz (2008).

Table A2: Changes in the College Wage Premium and the Supply and Demand for College Educated Workers: 1914 to 2017 (100 × Annual Log Changes)

	Changes in the Relative Wage	Changes in Relative Supply	Changes in Relative Demand (σ_{SU} = 1.62)
	(1)	(2)	(3)
1914-1939	-0.56	2.57	1.66
1939-1959	-0.51	2.63	1.80
1959-1979	0.07	3.51	3.63
1979-1999	1.19	2.28	4.21
1999-2017	0.20	1.96	2.28
1939-1979	-0.22	3.07	2.72
1979-2017	0.72	2.13	3.30
1914-2017	0.04	2.60	2.68

Sources: The underlying data are from the 1915 Iowa State Census, 1940 to 1970 Census IPUMS, and 1963 to 2018 CPS Merged Outgoing Rotation Group (MORG) samples.

Notes: The "relative wage" is the log (college/high school) wage differential, which is the college wage premium. The underlying college wage premium series is plotted in Figure 1. The relative supply and demand measures are for college "equivalents" (college graduates plus half of those with some college) relative to high school "equivalents" (those with 12 or fewer years of schooling and half of those with some college). Relative skill supplies are measured in efficiency units and are the same series using for the regressions in Table A1. The log relative demand measure (D_t) is based on equation (2) in the text and is given by
$D_t = \ln(L_{S_t}/L_{U_t}) + \sigma_{SU} \ln(w_{S_t}/w_{U_t})$, under the assumption that σ_{SU} = 1.62 based on the estimate from col. (2) of Table A1.

Table A3: Contribution of Changes in Returns to Schooling to Increased Hourly Wage Inequality, 1980 to 2017

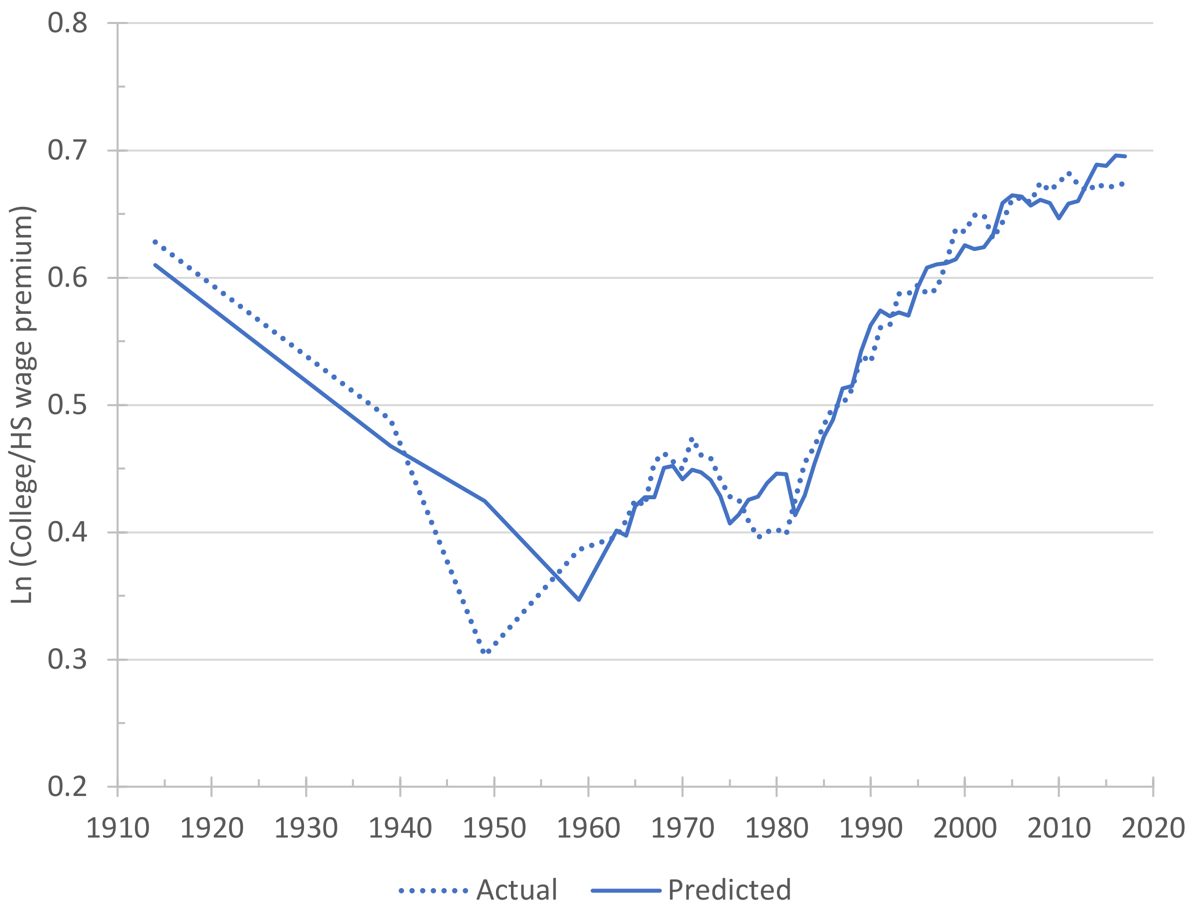
Panel A:	Var ln(w)	90-10	K to 12	College	Post-College
1980	0.250	1.247	0.063	0.077	0.067
2000	0.315	1.436	0.075	0.126	0.131
2017	0.374	1.553	0.062	0.141	0.176

Panel B:	Change in	Change in	Education Return Contribution	
	Var ln(w)	90-10	Var ln(w)	90-10
1980 to 2000	0.065	0.189	0.746	0.649
2000 to 2017	0.058	0.116	0.384	0.483
1980 to 2017	0.123	0.305	0.567	0.572

Sources and Notes: CPS MORG files for 1979 to 1981, 1999 to 2001, and 2016 to 2018. The samples include wage and salary workers aged 18 to 64 years with 0 to 39 years of potential experience using the data processing methods for the CPS May/MORG samples described in the appendix to Autor, Katz, and Kearney (2008). 1980 pools the 1979 to 1981 samples; 2000 pools the 1999 to 2001 samples; 2017 pools the 2016 to 2018 samples. Var ln(w) is the variance of the log hourly wage. 90-10 is the log 90-10 wage ratio. Education returns are estimated for each period from human capital earnings regressions with the log hourly wage as the dependent variable run on a linear spline in years of schooling with break points after 12 and 16 years of schooling; a quartic in experience; race, region, and gender dummies; year dummies; and interactions of gender and the experience quartic.

We examine the role of changing education returns from 1980 to 2017 by first imposing the 2017 returns to schooling on 1980, thereby adjusting individual wages in 1980. We then compare the distributions of actual and adjusted wages in 1980 to determine what wage inequality would have been with education returns at 2017 levels. We adjust 1980 wages to incorporate 2017 education returns by adding to each individual's wage in 1980 the sum of the product of that individual's years of schooling in each category (K-12, college, and post-college) and the difference between the estimated returns to schooling in 2017 and 1980 for that schooling category Wages in 2017 are analogously adjusted by imposing the 1980 education returns. The average of the results of the two simulations is then used. We repeat this approach for 1980 to 2000 and for 2000 to 2017.

Figure A1: Actual vs. Predicted College Wage Premium, 1914 to 2017



Source and Notes: The actual college wage premium is the series plotted in Figure 1. The predicted college wage premium series plots the predicted values for the college wage premium from the regression in col. (2) of Appendix Table A1.

Extended Figure Notes

Figure 1: The clerical/production worker wage ratio series for 1825 to 1875 is based on the mean daily wage of civilian white collar (clerical) and production workers (artisans and common laborers) hired by army forts for each decade from the 1820s to the 1880s using the series in Katz and Margo (2014, Table 1.5). Thus, the 1825 wage ratio is the mean wage ratio for 1821 to 1830, the 1835 ratio is the mean wage ratio for 1831 to 1840, etc. The mean production worker wage for 1825 to 1875 is given by 1/3 times the mean wage of artisans plus 2/3 times the mean wage of common laborers for each decade. The clerical/production worker series for 1890 to 1959 uses the ratio of clerical workers earnings to those of production workers for males in col. 2 of Table 2.2 in Goldin and Katz (2008). The 1939 to 1959 estimates directly use the wage ratios from the 1940 to 1960 Census IPUMS in the bottom panel of Table 2.2. The 1895 to 1939 ratios in the top panel of Table 2.2 are rescaled (multiplied by 1.032) to use the 1939 Census IPUMS ratio as the baseline. The 1890 clerical/production worker wage ratio is backcasted from the 1895 male wage ratio using the proportional change in female wage ratio for 1890 to 1895 in col (1) of Table 2.2. The 1825 to 1875 ratios are rescaled under the assumption of no change in the wage ratio from 1875 to 1890.

The high school wage premium series is the ratio of earnings of high school graduates to those with 8 years of schooling from Table D.1 of Goldin and Katz (2008).

The college wage premium series is a fixed weighted average of the estimated college (16 years of schooling) and post-college (17 or more years of schooling) log wage differential relative to high school graduates (12 years of schooling). The college wage premium series through 2005 is equivalent to the series used in Table 8.2 of Goldin and Katz (2008) and is updated through 2017 using the 2007 to 2018 March CPS. The college wage premium series uses data from the 1915 Iowa State Census, 1940 to 1970 Census IPUMS, the 1964 to 2018 March CPS samples. The data processing and sample selection procedures for March CPS samples follow those in Autor, Katz, and Kearney (2008) updated through the March 2018 CPS to cover earnings data through 2017.

Figure 2: The source data come from the 1940 to 2000 U.S. Census IPUMS and the 2005 to 2018 CPS MORG samples. The figure updates Figure 7 of Goldin and Katz (2007) adding the 1976 to 1987 birth cohorts using the CPS MORG samples for 2005 to 2018. Mean schooling estimates by cohort are adjusted to thirty years of age for the 1876 to 1975 birth cohorts using results of a regression of the log of mean years of schooling by birth cohort–year cell on a full set of birth cohort dummies and a quartic in age, using IPUMS data for 1940–2000. The samples include all native-born residents aged twenty-five to sixty-four.

For further details on the method and data processing, see Goldin and Katz (2008, figure 1.4). Mean years of schooling at age 30 for the 1976 to 1987 birth cohorts are the average of ages 29 to 31 years old for each birth cohort in the CPS MORG files for 2005 to 2018.