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Author(s): Chinhui Juhn, Kevin M. Murphy, Brooks Pierce
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Wage Inequality and the Rise in Returns to Skill

Chinhui Juhn

University of Houston

Kevin M. Murphy

University of Chicago

Brooks Pierce

Texas A&M University

Using data from the March Current Population Survey, we document an increase over the past 30 years in wage inequality for males. Between 1963 and 1989, real average weekly wages for the least skilled workers (as measured by the tenth percentile of the wage distribution) declined by about 5 percent, whereas wages for the most skilled workers (as measured by the ninetieth percentile of the wage distribution) rose by about 40 percent. We find that the trend toward increased wage inequality is apparent within narrowly defined education and labor market experience groups. Our interpretation is that much of the increase in wage inequality for males over the last 20 years is due to increased returns to the components of skill other than years of schooling and years of labor market experience. Our primary explanation for the general rise in returns to skill is that the demand for skill rose in the United States over this period.

I. Introduction

Between 1963 and 1989, the average weekly wage of working men increased by about 20 percent. However, as we show in this paper,

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these real wage gains were not spread equally across workers. Wages for the least skilled, as measured by the tenth percentile of the wage distribution, fell by about 5 percent, and wages for the most skilled, as measured by the ninetieth percentile of the wage distribution, increased by about 40 percent. Comparisons of 1989 with 1970 reveal similar differences. While real wages for the median worker were 5 percent lower in 1989 than in 1970, wages for workers at the ninetieth percentile were more than 15 percent higher in 1989 than in 1970. This 15 percent increase in real wages contrasts even more sharply with a 25 percent decline in real wages for workers at the tenth percentile of the wage distribution. Looking within education and experience categories reveals even more striking changes. Real wages for tenth percentile high school graduates with 1–10 years of experience are about 15 percent lower today than wages for the same group in 1963. In fact almost 40 percent of today's workers with 1–10 years of experience earn less than workers at the corresponding percentile in 1963.

The net result of this divergence in earnings between the most skilled and the least skilled has been an enormous increase in wage inequality. According to our calculations, the variance of log weekly wages increased by about 72 percent from 1963 through 1989. These findings are broadly consistent with the findings of others who have recently looked at inequality (see, e.g., Bluestone and Harrison [1988], Bluestone [1989], Levy [1989], or many of the studies cited in Sawhill [1988]). While the basic facts support the general trends identified in previous work, we feel that there are many unique components of our analysis as well. First, much of the inequality literature has focused on earnings or income as a measure of welfare rather than on wages, which are more closely related to market prices for human capital components. We believe that the emphasis on wages as prices, instead of on incomes, allows us to make several important contributions to this literature. In addition, we push our analysis in a somewhat different direction and describe more clearly the timing of the increase in overall inequality, decompose the increase in inequality into components accounted for by observable differences across workers (e.g., age and education) and inequality within these classifications, and finally evaluate some simple alternative explanations. Each of these points adds significantly to our understanding of the recent history of wage inequality.

Throughout the paper we interpret the dispersion in wages, after controlling for observable skill determinants, as a distribution of unobservable ability in the population in conjunction with a current market value of this unobservable ability. In particular, we view the trend toward increased inequality not in terms of increased dispersion in unobserved ability (or increased measurement error etc.) but rather as an increasing market return to skill. This characterization seems the most complete and compact available for the empirical facts we present. In addition, this characterization points to changes in skill demand as a likely explanation of the facts, an explanation that has some support in our data.

Our basic empirical findings are that wage inequality remained very stable or even declined slightly from 1960 to 1968 or 1969 and then increased relatively steadily through the end of the data. When we decompose this increase in inequality into a rise in inequality across observable dimensions of skill (i.e., experience and education) and a rise in inequality within schooling and experience groups, we find a substantial difference in the timing of the increase. For example, wage differentials by education actually increased from 1960 through 1970 (while overall inequality remained relatively stable) and then fell significantly over the 1970s (while overall inequality was rising). In contrast, the recent sharp rise in the returns to education (identified by Murphy and Welch [1992] and others) has been much greater than the recent rise in overall inequality. Our conclusion is that the general rise in inequality and the rise in education premia are actually distinct economic phenomena. In contrast to the education story, inequality within education and experience categories remained stable or fell over the 1960s and then rose steadily through the end of our data. The differences in the timing of the increases in wage inequality within and between groups represent one of the most important findings of this paper and point to a rise in the demand for skill that predates the recent rise in returns to education by about a decade. In spite of these differences in timing, we find that, on average, wage differentials both between and within groups have increased by between 30 and 50 percent since the late 1960s.

We consider two basic types of explanations for the general rise in returns to skill. The first explanation links the rise in returns to skill with a shift in labor demand both across and within industries that favors the most skilled. Using observed changes in the industry and occupation mix of the labor force as measures of the changing demand for skill, we find that employment has shifted toward industries and occupations that demand more skilled workers even in the face of rising skill premia. Overall, we find that the "demand" for the most skilled increased by about 50 percent relative to the demand for the least skilled. We do not as yet know what underlying forces (such as international competition) have led to these dramatic shifts in labor demand, but whatever the source, these changes would seem to be a major factor accounting for the rise in skill premia.

We also attempt to determine the extent to which changes in the composition of the work force (i.e., changes in age and education composition) and changes in the patterns of employment across occupations and industries have affected the level of wage inequality. On both margins we find that these composition effects are relatively unimportant. In particular, the shift of the economy to the service sector and changes in the occupation distribution have had only very minor influences on wage inequality (accounting for less than 15 percent of the increase).

It is important to stress the relevance of this conclusion to current research topics in labor economics. In particular, studies that make wage comparisons over time for groups that are relatively concentrated in the upper or lower tail of the wage distribution must consider the importance of rising skill prices. For example, the well-documented convergence of black and white wage rates over the 1940–80 period (Smith and Welch 1986) has slowed in the 1980s (Juhn, Murphy, and Pierce 1991). A substantial part of this slowdown in convergence is explainable by rising skill prices in combination with the fact that blacks are relatively concentrated in the lower half of the skill distribution (because, say, premarket discrimination has been manifested in lower quantity and quality of schooling for blacks). Similarly, some small part of the findings that entering cohorts of immigrants have become less skilled may be due to the fact that skill prices have risen (as opposed to skill quantities falling) over time (see, e.g., Borjas 1985; Chiswick 1986; LaLonde and Topel 1991).

The paper is organized as follows. Section II describes the data we use in our analysis. Section III presents our results on wage inequality and the rise in returns to skill. Section IV decomposes the rise in inequality into components associated with observed differences (education and experience) and the residual or unobserved component and identifies the time patterns of returns to alternative measures of skill. Section V attempts to explain the overall rise in the returns to skill in terms of demand changes and composition effects. Section VI relates our findings on wage inequality to changes in earnings inequality and points out several key differences between the series. Section VII presents concluding remarks.

II. The Data

The results in this paper are based on wage data for men drawn from 27 years of the March Current Population Survey (CPS), survey years 1964–90, and the 1960 decennial census. The data from the CPS come from the March annual demographic supplement and refer to earnings and weeks worked in the calendar year preceding the March survey. The data from the 1960 census refer to earnings and weeks worked in 1959. As a result, our sample measures wages for 1959 and 1963–89. Throughout the paper we focus on log weekly wages or log hourly wages for full-time workers (defined as those that usually work 35 hours or more per week). We deflate annual earnings by the personal consumption expenditure deflator from the National Income and Product Accounts and define the log average weekly wage as the natural logarithm of deflated annual wage and salary earnings divided by weeks worked and the log hourly wage as the natural logarithm of deflated annual wage and salary earnings divided by the product of weeks worked and usual weekly hours. We present initial analyses for both weekly and hourly wages and focus on weekly wages for the remainder of the results.

For purposes of analysis we selected a sample that we felt would be representative of workers with a reasonably strong labor force attachment. Our sample inclusion criteria were that the workers be aged 18–65, work full time, not be self-employed or working without pay, not live in group quarters, work at least 14 weeks, have a positive number of years of potential labor market experience, not work part of a year because of retirement or school, and earn a minimum of $67 per week in 1982 dollars (equal to one-half of the 1982 real minimum based on a 40-hour week). We imputed weekly earnings for workers top-coded at the census maximum as 1.33 times the top-coded value. For the most part, the qualitative results in the paper are not sensitive to the exclusion and imputation procedures we used. The one major exception is the exclusion of workers earning less than half of the real 1982 minimum wage. When these workers are included, wage inequality actually declines somewhat more over the 1963–69 period. For example, when these workers are included, the log weekly wage differential between the ninetieth and tenth percentiles falls by three points from 1963 to 1969, whereas in our reported results it actually rises slightly. This distinction, however, does arise for other time periods. The question of whether one believes that wage differentials fell or remained stable over the late 1960s turns on the credibility one lends to these relatively extreme observations.

In previous versions of this paper we noted that because of changes in the survey structure between the 1975 and 1976 surveys (wage data for 1974 and 1975), measured inequality dropped significantly. We have subsequently been able to overcome most of this problem by improving our predictions of weeks and hours worked last year, deleting all individuals with imputed wage and salary information, and excluding self-employed workers on the basis of the existence of any significant self-employment income (i.e., those with negative self-employment income or more than $100 [1982] of self-employment income). While it appears that some spurious fall in inequality still occurs between 1974 and 1975, particularly in the lowest and highest deciles, we do not use any correction factors in this version. In fact, the results reported here are very close to our previous corrected numbers and not the previous uncorrected numbers, which gives us considerable confidence that our prior corrections were in fact moving our answers in the right direction.

III. The Rise in Inequality

Figure 1 graphs the median, tenth percentile, and ninetieth percentile of the real weekly wage distribution of men for 1963–89. For ease of comparison, wages for the three groups are indexed to an average of 100 in 1963 and 1964 for all three series. The median wage series tells a well-known story. Real wages increase relatively steadily from 1963 through about 1973, decline sharply from 1973 through 1975, rise slightly from 1975 through 1977, decline from 1977 through 1982, and then recover somewhat from 1983 through 1985, only to fall back again from 1985 to 1989. The basic story is that real wages were about 25 percent higher in 1973 than in 1963 and 1964 and about 5 percent lower in 1989 than in 1973. As is clear from the figure, the story is significantly different for the tenth and ninetieth percentiles. For the least skilled (proxied here by the tenth

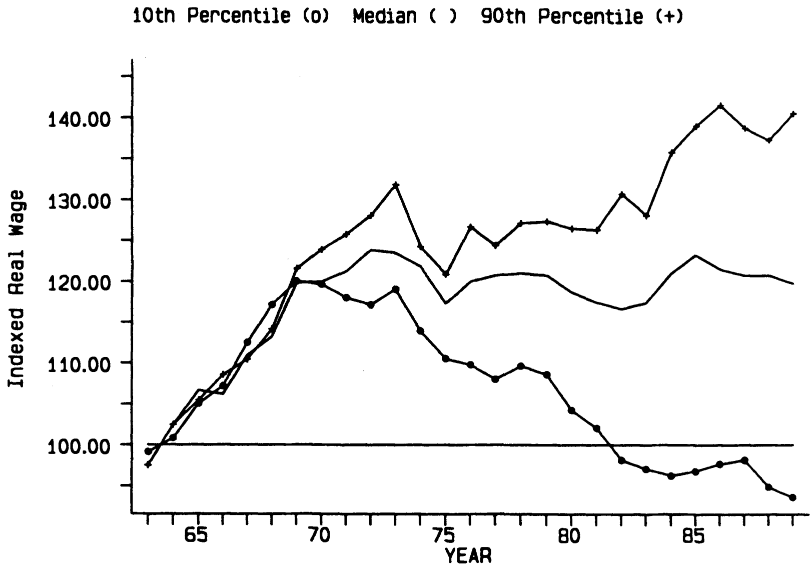

FIG. 1.—Indexed real weekly wages by percentile, 1963–89

percentile), wages rose by about 20 percent from 1963 through 1970 and then declined by 25 percent from 1970 through 1989. In contrast, real wages for workers at the ninetieth percentile rose steadily from 1963 through 1973 (by about 31 percent), declined by about 10 percent over the next 2 years, and then rose about 20 percent from 1975 through 1989. After about two and one-half decades, workers in the top 10 percent of the wage distribution have gained almost 40 percent, whereas workers in the bottom 10 percent have lost over 5 percent in real terms.

The data before and after 1970 provide a stark contrast. Between 1963 and 1970, wages for both the ninetieth and tenth percentiles increased by about 20 percent. Since 1970, workers at the tenth percentile have lost about 25 percent in real terms, whereas workers at the ninetieth percentile have gained about 15 percent. Figure 2 tells a similar story for hourly wages. The only significant differences are that real hourly wages grow more for both low-wage (tenth percentile) and high-wage (ninetieth percentile) workers than for the median worker and that median hourly wages fall more rapidly than median weekly wages over the late 1980s. Figure 3 shows that this rapid divergence in wages is not limited to comparisons of the most and least skilled. The figure gives the percentage change in real weekly wages by percentile over the 1963–89 period. As the figure illustrates, the change in log real wages from 1964 to 1988 is basically

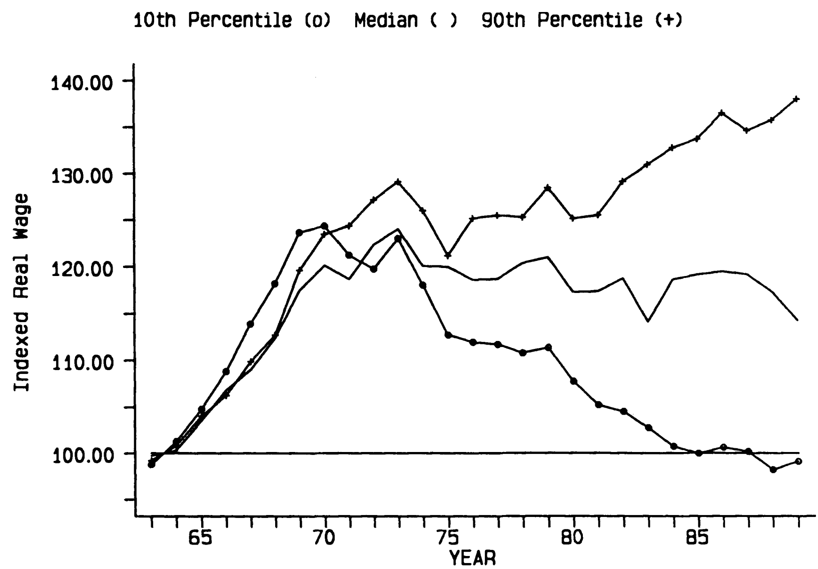

FIG. 2.—Indexed real hourly wages by percentile, 1963–89

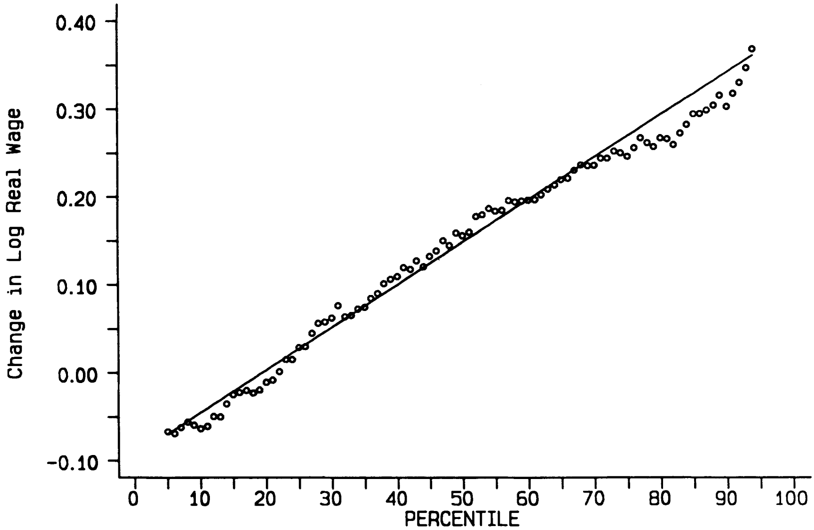

FIG. 3.—Log real wage changes by percentile, 1964–88

a linear function of the percentile, with workers at the upper end gaining about 40 percent and workers in the lowest percentiles losing about 5 percent. As the figure shows, the divergence in wages across percentiles is pervasive and is not limited to a specific part of the wage distribution. Skill differentials have increased at all points in the skill distribution.

The four panels in figure 4 decompose the change in weekly wage inequality from 1963 through 1989 into four subperiods. In order to minimize the effects of measurement error, we look at changes between 3-year averages. Panel A compares wages by percentile for the period 1969–71 with wages for 1963–65. The wage changes are normalized by comparing the change at each percentile with the mean change in log wages over that time interval. As panel A shows, the increase in inequality between 1963–65 and 1969–71 was quite modest overall. Over the period, workers at the lowest percentiles (below the tenth) actually gain slightly on the mean and median worker (thus reducing wage inequality), and workers at the upper percentiles (above the eightieth) also gain on the median worker (thus raising inequality). The basic message of panel A is that inequality between the most skilled and the average worker increased slightly during the late 1960s but inequality between the median worker and the lowest percentiles may have actually declined slightly. As we mentioned in Section II, this convergence may be even somewhat larger depending on how one treats low-wage observations.

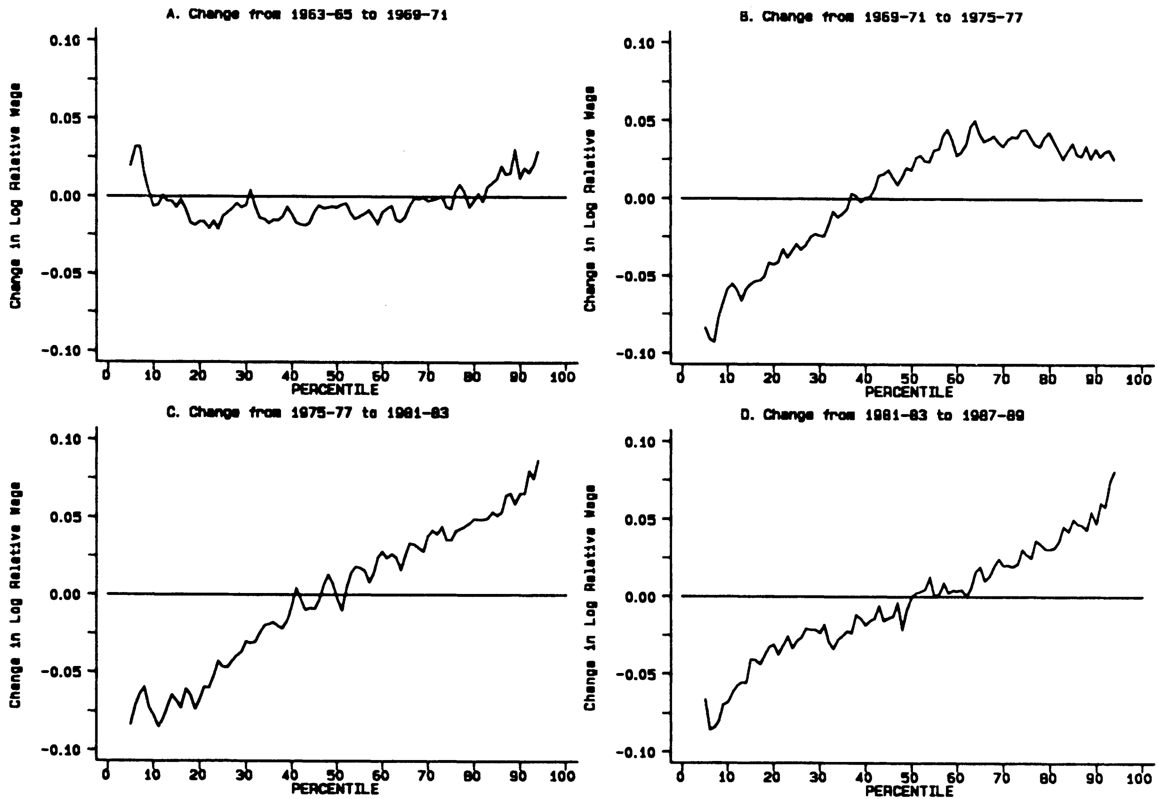

FIG. 4.—Changes in relative wages by percentile, 1963–89

The next three panels show much clearer moves toward greater wage inequality. In the six years from 1969–71 to 1975–77, workers at or below the tenth percentile of the wage distribution lost about 7 percent relative to the average (9 percent relative to the median), and workers in the upper quartile gained about 3–4 percent on the average worker. The changes from 1975–77 to 1981–83 are slightly larger, particularly at the extreme upper percentiles, but the overall nature of change remains the same. Workers at the upper percentiles gained significantly (about 7 percent) relative to the average, and workers at the lowest percentiles lost about 6–7 percent. The change over the most recent period (from 1981–83 to 1987–89) is about the same. Workers at the lowest percentiles lose about 7 percent relative to the mean, and workers at the highest percentiles gain about 7 percent. Again, as in the change for 1963–89 as a whole, the expansion in wage differentials by percentiles is pervasive. The percentage increase in wages is roughly a linear function of the percentile, with wage increases being 1.4 percent higher for each 10 percentile points up in the wage distribution.

Table 1 quantifies these changes by giving inequality measures for 1959 (i.e., from the 1960 census) and the same 3-year intervals used to summarize changes in figure 4. Panel A presents results for weekly wages, and panel B presents results for hourly wages. From 1959 to 1988 (the mean year of the final interval), the standard deviation of weekly wages increases from .44 to .59, an increase of about 33 percent. Similarly, the log wage differential between the ninetieth and tenth percentiles increases from 1.05 to 1.46, an increase of 42 percent. Over the full period the increase in inequality has been slightly larger below the mean than above the mean. The differential between the ninetieth percentile and the median increased by .17, and the difference between the median and the tenth percentile increased by .23. Similarly, the seventy-fifth percentile–median differential increased by .10, and the median–twenty-fifth percentile differential increased by .15. In spite of the differences, the basic message is that inequality has increased substantially in all parts of the wage distribution. The general pattern of accelerating change shown in figure 4 comes through in the comparisons in table 1 as well.

The results presented so far refer only to changes in the overall wage distribution and do not tell us how these changes break down into changes within groups (defined by education and experience) and changes between groups. They also do not tell us whether the changes have been greater for some subgroups than for others. Figure 5 addresses both of these issues by looking at log wage changes by percentile separately for workers with 1–10 years of experience and workers with 21–30 years of experience. The percentile numbers

TABLE 1

Inequality Measures for Log Wages of Men, 1959–88

	1959	1964	1970	1976	1982	1988
			A. Weekly Wages			
Standard deviation	.44	.45	.46	.49	.54	.59
Percentile differential:						
90-10	1.05	1.09	1.12	1.21	1.34	1.46
	(.0029)	(.0066)	(.0050)	(.0054)	(.0053)	(.0057)
75-25	.50	.53	.54	.61	.69	.75
	(.0015)	(.0033)	(.0029)	(.0031)	(.0033)	(.0036)
90-50	.49	.51	.54	.55	.61	.66
	(.0021)	(.0042)	(.0035)	(.0036)	(.0039)	(.0042)
50-10	.57	.57	.58	.66	.74	.80
	(.0021)	(.0053)	(.0037)	(.0042)	(.0041)	(.0045)
75-50	.24	.26	.26	.29	.31	.34
	(.0010)	(.0026)	(.0021)	(.0022)	(.0024)	(.0027)
50-25	.26	.26	.28	.32	.37	.41
	(.0013)	(.0025)	(.0021)	(.0025)	(.0028)	(.0031)
Observations	212,127	42,780	54,369	54,760	59,922	66,669
			B. Hourly Wages			
Standard deviation	.45	.46	.46	.49	.53	.57
Percentile differential:						
90-10	1.05	1.11	1.10	1.21	1.32	1.43
	(.0027)	(.0063)	(.0050)	(.0052)	(.0051)	(.0052)
75-25	.51	.53	.53	.62	.70	.75
	(.0015)	(.0036)	(.0029)	(.0032)	(.0034)	(.0033)
90-50	.49	.51	.53	.54	.60	.66
	(.0018)	(.0039)	(.0034)	(.0035)	(.0036)	(.0038)
50-10	.56	.60	.57	.67	.72	.77
	(.0020)	(.0050)	(.0038)	(.0041)	(.0040)	(.0041)
75-50	.25	.26	.26	.29	.32	.35
	(.0010)	(.0024)	(.0020)	(.0022)	(.0024)	(.0024)
50-25	.26	.28	.27	.33	.38	.40
	(.0012)	(.0028)	(.0022)	(.0026)	(.0028)	(.0028)
Observations	212,127	42,780	54,369	54,760	59,922	66,669

Note.—Standard errors are in parentheses. Data for 1964–88 are 3-year averages of surrounding years from 1964–90 March Current Population Surveys. Data for 1959 are taken from the 1960 Public Use Micro Census Tapes.

on the bottom refer to percentiles of the individual groups' wage distribution. As the figure illustrates, wage differentials across experience groups have increased at all percentiles (with a slightly larger divergence at the mean than at the extremes). Overall, the wage differential between the groups increased by about .20. Given the existing positive wage differential between those with 21–30 years of experience and those with 1–10 years of experience, this change has served to increase overall wage inequality. Inequality has also gone up enormously within each group. For the youngest group we find

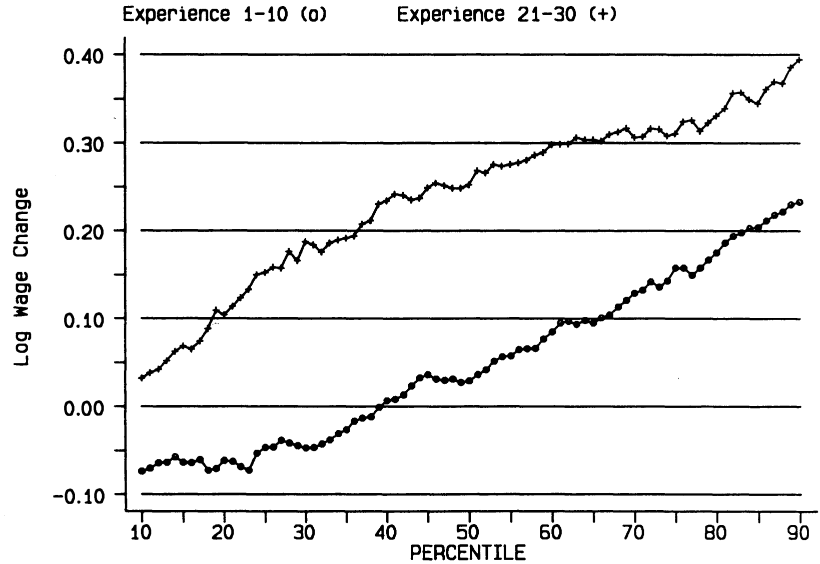

FIG. 5.—Estimated wage change by percentile, 1964–88

that workers at the tenth percentile have lost about 7 percent in real terms, whereas workers at the ninetieth percentile have gained almost 25 percent. Among the older group, workers at the tenth percentile gain about 3 percent (about the same as the median worker in the younger group) and workers at the ninetieth percentile gain about 39 percent. On the basis of these calculations, it seems that the increase in inequality is about the same for both experience groups (in fact it is also quite similar for those with 11–20 years of experience and only slightly smaller for those with more than 30 years of experience).

One message from figure 5 that will continue throughout the paper is that the increase in wage inequality shows up both between and within groups. As a result, while we can say that older workers have gained relative to younger workers as a whole, it is still true that the highest-paid among the youngest workers (say the ninetieth percentile) have gained relative to the lowest-paid (or even the twenty-fifth percentile) older worker.

One of the most striking things about figure 5 is that for the lowest 40 percent of younger workers, real wages are lower in 1988 than for the corresponding group in 1964! Hence for two-fifths of all younger workers there has been no increase in economic opportunity as measured by weekly wage rates in about two and one-half decades.

Figure 6 breaks things down still further by looking at real wage

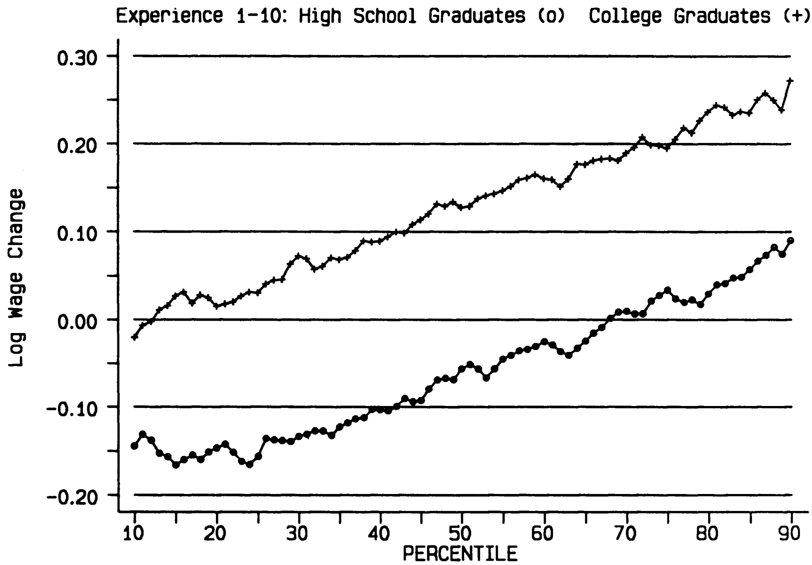

FIG. 6.—Estimated wage change by percentile, 1964–88

changes for high school and college graduates for workers with 1–10 years of experience. As with the experience contrasts shown in figure 5, the between-group differential moved in the direction of greater inequality, with college graduates gaining on high school graduates at all percentile levels. The gains for college graduates relative to high school graduates are very similar at all percentiles above the twentieth, with college graduates gaining about 20 percent relative to high school graduates.

The increases in inequality within a group are equally striking. High school graduates at the ninetieth percentile gained about 9 percent in real terms from 1964 to 1988, whereas high school graduates at the tenth percentile lost about 15 percent in real terms. The data in figure 6 imply that the bottom 40 percent of high school graduates with 1–10 years of experience earn 10–17 percent less than the corresponding workers in 1964. In fact only the top 30 percent of young high school graduates have gained in real terms since 1964. The relative wage changes for college graduates show a similar increase in inequality, with the ninetieth percentile college graduates gaining about 25 percent and the tenth percentile college graduates losing slightly less than 5 percent. As in the experience calculation described above, this large increase in within-group inequality implies that while college graduates gained on high school graduates as a whole, the best high school graduates (say the ninetieth percentile) gained significantly on the low-end college graduates (say the tenth percentile).

The basic message of figures 5 and 6 is that wage inequality has increased significantly within groups defined by experience and education. Table 2 takes this analysis one step further by looking at the distribution of regression residuals from a regression of log weekly wages on a very flexible specification of education and experience effects.[1] Looking at regression residuals allows us to look within very narrowly defined education and experience categories. A striking feature of the table is the similarity of the inequality measures for 1959 and 1970. Apparently there was very little change in within-group inequality over the 11 years from 1959 to 1970. In contrast, the period from 1970 to 1988 is characterized by an enormous increase in inequality, with workers at the ninetieth percentile of the residual distribution gaining about 26 percent relative to workers at the tenth percentile.

To understand the magnitude of the changes we describe, consider the following frame of reference. In 1964 the standard deviation of log weekly wages was .45, from table 1. In 1988 the standard deviation based on regression residuals was approximately .49, from table 2. This means that wage inequality as measured by standard deviations rose by an amount greater than the predictive power of the observables in our wage equation. The magnitude of the inequality increase is greater than the wage variation explainable by experience and education combined.[2]

As stated in the Introduction, we view this increase in within-group wage inequality as a trend toward higher skill prices. However, the argument could be made that it is the result of increased dispersion in unobserved ability within recent entry cohorts due to, say, increasingly unequal educational opportunities. To evaluate this potential objection, table 3 documents wage inequality growth over time within synthetic cohort groups. Panel A gives the ninetieth-tenth percentile differential for log weekly wages of various 6-year entry cohorts. One follows a cohort over time by moving horizontally across columns within the same row. One follows the same experience group over time by moving upward along a diagonal (those who enter in 1959–64 have the same experience level in 1964 as entrants in 1965–70 do in 1970). Within cohorts, inequality changes over time are attributable

[1] We estimated a wage equation with education dummies for less than high school, high school, some college, and college graduates and with linear terms in education within these groups. The regressions also include a quartic in experience fully interacted with the education variables and regional dummies.

[2] Typically, education and experience observables can explain about a quarter to a third of the observed log weekly wage variation in a cross-sectional regression.

TABLE 2

Inequality Measures Based on Regression Residuals for Men, 1959–88

	1959	1964	1970	1976	1982	1988
Standard deviation	.38	.39	.39	.41	.45	.49
Percentile differential:						
90-10	.89	.94	.92	.99	1.10	1.18
	(.0022)	(.0053)	(.0042)	(.0044)	(.0046)	(.0048)
75-25	.43	.46	.46	.50	.57	.60
	(.0012)	(.0030)	(.0024)	(.0026)	(.0028)	(.0028)
90-50	.42	.44	.44	.46	.51	.54
	(.0014)	(.0035)	(.0029)	(.0029)	(.0031)	(.0033)
50-10	.47	.50	.48	.53	.59	.64
	(.0017)	(.0042)	(.0033)	(.0036)	(.0037)	(.0038)
75-50	.22	.22	.22	.24	.28	.28
	(.0008)	(.0021)	(.0017)	(.0018)	(.0020)	(.0020)
50-25	.22	.24	.23	.26	.30	.32
	(.0009)	(.0023)	(.0019)	(.0020)	(.0022)	(.0023)
Observations	212,127	42,780	54,369	54,760	59,922	66,669

Note.—Data for 1964–88 are 3-year averages of surrounding years from 1964–90 March Current Population Surveys. Data for 1959 are taken from the 1960 Public Use Micro Census Tapes.

to age or time effects. In contrast, changes in inequality within an experience group are due to cohort or time effects. As in tables 1 and 2, data are 3-year averages for surrounding years.

Obviously changes within recent cohorts cannot adequately explain the trends toward greater inequality because past cohorts have also experienced this trend in recent years. But the striking feature of table 3 is that changes over time within cohorts (along rows) and within experience groups (along diagonals) show remarkably similar patterns. For example, the ninetieth-tenth percentile wage differential within the 1959–64 entry cohort increased from 1.13 in 1964 to 1.40 in 1988, and the differential for the 1–6 years of experience group increased from 1.13 to 1.38. Further, the timing of the increases is quite similar across the two series.

We summarize the growth of inequality within experience and cohort groups by averaging 6-year changes across the six cohort groups for which comparisons can be made. The average change within a cohort has the same magnitude and time pattern as that within an experience group. This basically means that the older cohorts leaving the data and the new cohorts entering the data across a 6-year span have similar levels of inequality. We obtain the same results using wage residuals in panel B of table 3. Given the fact that inequality increases are age-neutral in the cross section (fig. 5), we surmise that the similarity of entering and exiting cohorts implies that trends toward inequality are due mainly to increasing skill prices over time, and not to increasing dispersion of quality in more recent cohorts.

TABLE 3

CHANGES IN INEQUALITY BY COHORT, 1963–89

A. 90-10 DIFFERENTIALS FOR LOG WEEKLY WAGES

Year of Market Entry	1964	1970	1976	1982	1988
1983–88					1.38
1977–82				1.27	1.38
1971–76			1.13	1.24	1.38
1965–70		1.08	1.12	1.29	1.42
1959–64	1.13	1.01	1.13	1.30	1.40
1953–58	1.02	1.07	1.16	1.32	1.43
1947–52	1.02	1.11	1.15	1.30	
1941–46	1.02	1.07	1.16		
1935–40	1.06	1.09			
1929–34	1.09				

Average Changes within Cohorts and Experience Levels

Average Change	1964–70	1970–76	1976–82	1982–88
Within cohorts	.018	.073	.153	.115
Within experience levels	.015	.069	.145	.110

B. 90-10 DIFFERENTIALS FOR LOG WAGE RESIDUALS

	1964	1970	1976	1982	1988
1983–88					1.09
1977–82				1.06	1.16
1971–76			.96	1.09	1.18
1965–70		.86	.96	1.12	1.23
1959–64	.92	.86	.98	1.12	1.21
1953–58	.88	.91	.99	1.15	1.26
1947–52	.89	.94	.99	1.14	
1941–46	.94	.94	1.05		
1935–40	.95	.98			
1929–34	.99				

Average Changes within Cohorts and Experience Levels

Average Change	1964–70	1970–76	1976–82	1982–88
Within cohorts	.007	.096	.145	.101
Within experience levels	−.016	.076	.123	.076

Of course, it is possible that cohort and age effects are equal and have such a magnitude as to appear to be time effects. This follows from the usual identification problem arising when one tries to separate cohort, age, and time effects. While we cannot calculate growth in inequality over time separately from inequality growth across cohorts and ages, we can identify the *change* in inequality growth over time. We can difference inequality measures within a cohort (eliminating the cohort effect) and compare this difference across adjacent cohorts (eliminating the age effect and leaving only a change in inequality growth over time). From table 3 we can see that this is identical to comparing the average changes within cohorts over time. Since the average change within a cohort from 1964 to 1970 is much smaller than the changes across later 6-year periods, we know that the data indicate an accelerating increase in inequality with time that cannot be explained by any combinations of cohort and age effects.

Given these data, we interpret increasing inequality over time as arising mainly from increasing skill prices, and not from changes in the distributions of unobservable skill quantities. In the following section we present a framework that attempts to quantify the contribution of changing observable quantities, observable prices, and prices of unobservables to the overall increase in inequality.

IV. Components of Change in Wage Inequality

Panel A in figure 7 plots the time series of overall wage inequality as measured by the log wage differential between the ninetieth and tenth percentiles of the wage distribution. As the figure illustrates, overall inequality was quite stable from 1963 to 1968. After 1968, wage inequality increased relatively steadily through the end of our data. Our basic interpretation of this change is that the wage premium for skill was stable during the 1960s and the skill premium has increased by about 35 percent since the late 1960s. As we have shown, this rise in skill premia applies to both observable dimensions of skill (i.e., education, experience, and occupation) and unobservable dimensions of skill (the residual). A useful framework for isolating these effects is to write a simple wage equation such as

$$Y_{it} = \mathbf{X}_{it}\beta_t + u_{it}, \tag{1}$$

where Y_{it} is the log weekly wage for individual i in year t, $\mathbf{X}_{it}$ is a vector of individual characteristics (including experience and education effects), and u_{it} is the component of wages accounted for by the unobservables. For our purposes it will be useful to think of this residual as two components: an individual's percentile in the residual distribution, θ_{it}, and the distribution function of the wage equation residuals, $F_t(\,)$. By definition of the cumulative distribution function, we have

$$u_{it} = F_t^{-1}(\theta_{it}|\mathbf{X}_{it}), \tag{2}$$

where $F_t^{-1}(\cdot|\mathbf{X}_{it})$ is the inverse cumulative residual distribution for workers with characteristics $\mathbf{X}_{it}$ in year t.

In this framework changes in inequality come from three sources: changes in the distribution of individual characteristics (i.e., changes

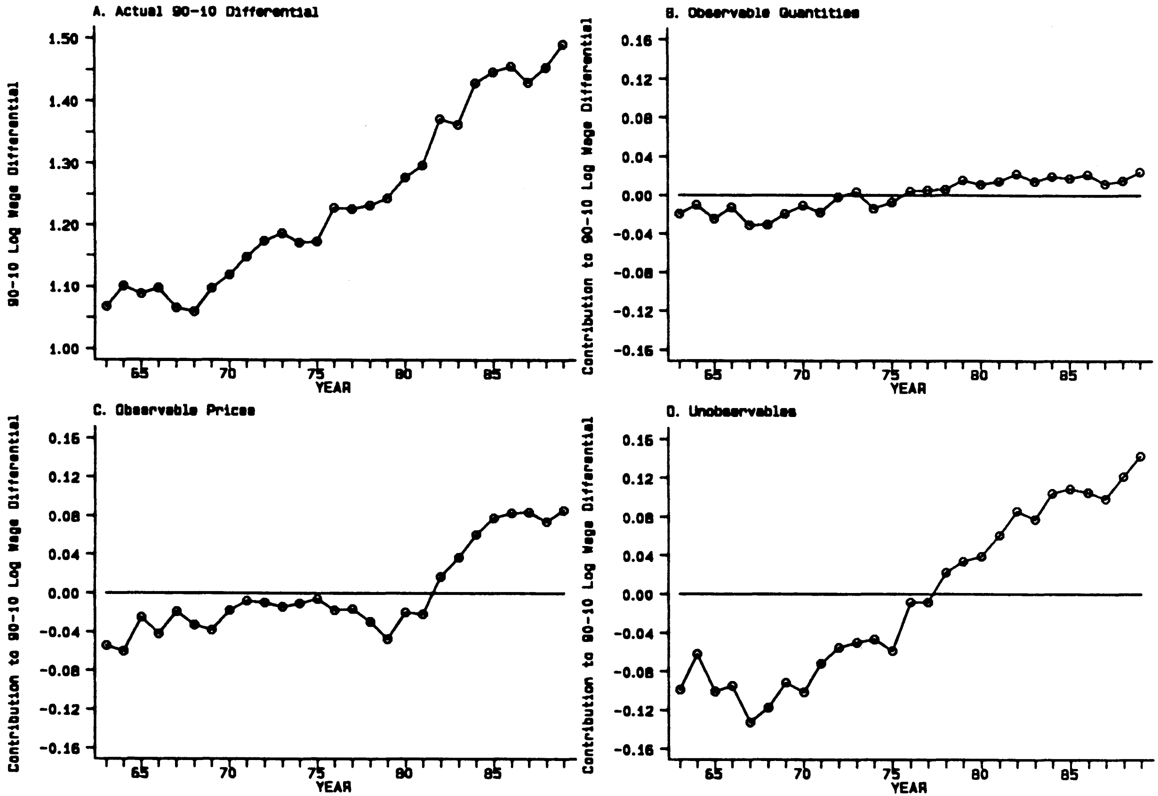

FIG. 7.—Ninetieth-tenth percentile log wage differential and components, 1963–89

in the distribution of the **X**'s), changes in the prices of observable skills (i.e., changes in the β's), and changes in the distribution of the residuals. If we define $\bar{\beta}$ to be the average prices for observables over the whole period and $\bar{F}(\cdot|\mathbf{X}_{it})$ to be the average cumulative distribution, we can decompose the level of inequality into corresponding components as

$$\begin{aligned} Y_{it} &= \mathbf{X}_{it}\bar{\beta} + \mathbf{X}_{it}(\beta_t - \bar{\beta}) + \bar{F}^{-1}(\theta_{it}|\mathbf{X}_{it}) \\ &\quad + [F_t^{-1}(\theta_{it}|\mathbf{X}_{it}) - \bar{F}^{-1}(\theta_{it}|\mathbf{X}_{it})]. \end{aligned} \tag{3}$$

The first term captures the effect of a changing education and experience distribution at fixed prices. The second term captures the effects of changing skill prices for observables at fixed **X**'s, and the final term captures the effects of changes in the distribution of wage residuals. Armed with this simple framework, we can reconstruct what the wage distribution would look like with any subset of components held fixed. For example, with fixed observable prices and a fixed residual distribution, wages would be determined as

$$Y_{it}^1 = \mathbf{X}_{it}\bar{\beta} + \bar{F}^{-1}(\theta_{it}|\mathbf{X}_{it}). \tag{4}$$

In practice, we can estimate how this distribution would have changed through time by predicting wages for all workers in the sample in year t using the average coefficients, $\bar{\beta}$, and computing a residual for each worker based on his actual percentile in that year's residual distribution and the average cumulative distribution over the full sample. The major advantage of this over the more standard variance accounting framework is that it allows us to look at how composition changes have affected the entire wage distribution and not just the variance. We can determine how changes in the distribution of observables have affected other inequality measures such as the interquartile range or the ninetieth-tenth percentile differential or how the effects have been different for inequality above and below the mean.

If we want to allow both observable prices and observable quantities to vary through time, then we can generate wages by

$$Y_{it}^2 = \mathbf{X}_{it}\beta_t + \bar{F}^{-1}(\theta_{it}|\mathbf{X}_{it}). \tag{5}$$

In this case we predict wages for each worker in year t given his observable characteristics and the wage equation estimated for year t and again assign him a residual based on the cumulative distribution for all years. Finally, if we allow observable prices and quantities and the distribution of residuals to change through time, we obtain

$$Y_{it}^3 = \mathbf{X}_{it}\beta_t + F_t^{-1}(\theta_{it}|\mathbf{X}_{it}) = \mathbf{X}_{it}\beta_t + u_{it} = Y_{it}, \tag{6}$$

which replicates the actual wage distribution since $u_{it} = F_t^{-1}(\theta_{it}|\mathbf{X}_{it})$ by definition of the cumulative wage distribution.

Our basic technique will be to calculate the distribution of Y_{it}^1, Y_{it}^2, and Y_{it}^3 for each year and attribute the change through time in inequality in the Y_{it}^1 distribution to changes in observable quantities. We then attribute any additional change in inequality in Y_{it}^2 to changes in observable prices, and finally we attribute any additional changes in inequality for Y_{it}^3 beyond those found for Y_{it}^2 to changes in the distribution of unobservables (i.e., changes in unmeasured prices and quantities). The same analysis can be done in other orders and would simply rearrange the assignment of interaction terms.

The remaining three panels in figure 7 give the part of the ninetieth-tenth percentile log wage differential accounted for by each of these three components (each is measured as a deviation from its overall mean). Panel B gives the effects of changes in the distribution of observables. As is clear from the figure, changes in observable characteristics have had only a very modest impact on overall inequality. This implies that the changes in the age and education composition of the work force have not had a direct effect on the level of inequality (with skill prices held fixed). Panel C looks at the component of changes in inequality due to changes in observable prices (i.e., changes in the returns to education and experience). As the figure illustrates, changes in observable prices had a very modest effect on inequality until about 1980. Since 1980, however, the rapid increases in education differentials and returns to experience (for the less educated groups) have increased the ninetieth-tenth percentile log wage differential by about 12 percentage points (more than half of the total increase over the 1980s).

Panel D examines the component due to changes in unmeasured prices and quantities (i.e., the residual). As the figure shows, this component is by far the most important for the overall increase in inequality (accounting for about two-thirds of the increase). Moreover, unlike the increase in observable skill prices, the increase in inequality based on unobservables has been operating since the late 1960s. While it is fair to say that skill premia based on both observed skill differences and unobserved skill differences have increased since 1970, it is important to note that the timing of these changes is very different. The rise in within-group inequality (measured by the residual component) preceded the increase in returns to observables by over a decade. On the basis of this difference in timing, it seems clear to us that there are at least two unique dimensions of skill (education and skill differences within an education group) that receive unique prices in the labor market.

Table 4 quantifies the contribution of observed quantities and

TABLE 4

Observable and Unobservable Components of Changes in Inequality

Differential	Total Change (1)	Observed Quantities (2)	Observed Prices (3)	Unobserved Prices and Quantities (4)
		A. 1964–88		
90-10	.373	.035	.128	.208
90-50	.146	.020	.068	.061
50-10	.227	.015	.060	.147
		B. 1964–79		
90-10	.165	.029	.014	.119
90-50	.059	.011	.010	.036
50-10	.106	.018	.004	.083
		C. 1979–88		
90-10	.208	.006	.114	.089
90-50	.087	.009	.058	.026
50-10	.121	−.003	.056	.064

Note.—The years refer to the middle point of the 3-year interval. Col. 1 gives the change in the indicated statistics over the years shown. Components in cols. 2–4 are calculated on the basis of the full distribution accounting scheme outlined in the text.

prices and the unobservables to the increase in the standard deviation as well as the increase in the ninetieth-tenth percentile differential. The major information contained in the table that was not apparent in figure 7 is the difference in explanatory power for inequality above and below the mean. This ability to estimate how different parts of the wage distribution have been affected by the various components is the major advantage of the full distribution accounting scheme proposed here over the more conventional variance accounting framework.

Panel A in table 4 refers to the change over the period 1964–88 (the years refer to the middle year of the 3-year interval). As the table shows, changes in observed quantities account for only about 7 percent of the increase in wage inequality between the fiftieth and tenth percentiles (primarily because of the decline in the number of men with very low education levels) but have accounted for about 14 percent (i.e., .020/.146) of the increase in inequality above the mean. Similarly, the rise in observable prices (primarily the increase in college returns) has accounted for about 47 percent of the increase in the ninetieth-fiftieth percentile differential but only about 26 percent of the growth in the fiftieth-tenth percentile differential. As a result, the unobserved component accounts for 65 percent of the increase in inequality for those below the median but less than half of the increase in inequality for those above the median. Apparently, the increasing wage gap between the highest wage earners and the average is much more understandable in terms of observables than the even larger increase in the wage gap between the average and the low end.

Panels B and C perform the same decomposition for the periods before and after 1979 (the time in which education returns began to rise). For the 1964–79 period, the observables combine for a slight increase in overall inequality (with the increase in inequality generated by changing composition exceeding any effect on inequality generated by the fall in returns to education). Unobservables account for the vast majority of the increase in inequality, accounting for over 60 percent of the rise in the ninetieth-fiftieth percentile differential and 78 percent of the increase in inequality below the median. Panel C looks at the most recent period. For this period the changes in observed prices account for the dominant portion of the increase in inequality. However, even for this period, unobservables remain important, accounting for about 53 percent of the increase in inequality below the median.

The results in table 4 reinforce the finding of figure 7 that the timing of the increase in inequality has been very different for the observables and unobservables. This suggests that the notion of skill or a rise in returns to skill may be too broad and that it may be useful to distinguish alternative types and hence alternative "prices" of skill. Under this interpretation, the 1970s were characterized by a rapid rise in the returns to skills within education and experience categories but no significant rise in returns to skill across these categories. In contrast, the 1980s were characterized by a rise in returns to both observed and unobserved skill. Figure 8 addresses this issue by plotting three skill "prices" for education, experience, and within-group skills. The price series were derived from yearly regressions of log weekly wages on education and experience effects, as follows. Within-group skill price is the ninetieth-tenth percentile log wage differential from the regression residuals. The education skill price is an unweighted average of the college–high school log wage differential across experience levels. Similarly, skill prices for experience are constructed from the average log wage differential within education levels between the 26–35 and 1–10 experience groups. Each of these differentials is indexed to its 1963–64 average.

The pattern for the within-group differential tells a familiar story. Skill differentials within a group were steady until the late 1960s and then increased greatly from 1970 to 1989. Within-group differentials end up being about 30 percent larger in 1989 than in 1963. The

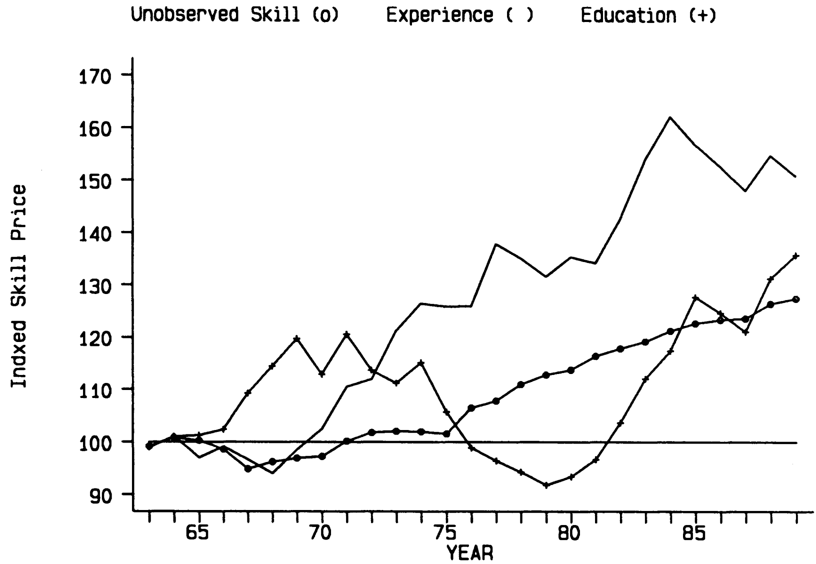

FIG. 8.—Skill price indexes for men, 1963–89 (1963/64 = 100)

price of education shows a very different pattern. Education returns increased over the 1960s (within-group differentials were stable) and decreased significantly over the next decade. By 1979 the education premium had fallen roughly 10 percent below its value in 1963. Since 1979 the education premium has skyrocketed, so that by 1989 it stood more than 25 percent above its value in 1963. The experience returns show a still different pattern. Experience returns fall slightly over the late 1960s and then rise rapidly (primarily for college graduates) with the arrival of the baby boom cohorts in the early 1970s. Experience returns then rise slowly over the next 7–8 years before rising rapidly in the early 1980s with the collapse of wages for less skilled younger workers. The basic message we take away from figure 8 is that all skill premia have increased greatly since 1963 but that these increases have shown quite different timing (particularly for education and within-group skills).

V. Accounting for the Rise in Returns to Skill

The skill prices shown in figure 8 show that returns to a wide variety of skills have increased over the past two and one-half decades. Given the rapid rise in average education levels over this period (from 10.9 years of schooling in 1963 to 12.3 years of schooling in 1989), such a large increase in skill premia must have resulted from a significant demand shift toward the most skilled. Such a shift in labor demand can be due to either a shift across industries toward industries that demand more skilled workers or a technological shift within industries toward production methods that favor the most skilled. To measure these shifts empirically, we divided the economy into the 12 industries and 11 occupation categories given in table 5. The columns of the table give the fractions of workers in the bottom 10 percent, the middle 10 percent, and the top 10 percent of the wage distribution employed in each occupation and industry. As the table shows, skill composition varies significantly across industry and occupation categories. As a result, shifts in industrial and occupational composition should generate significant changes in relative demand.

To construct a demand index, we write the output of an occupation by industry cell (this can be thought of as an intermediate good) as

$$Y_{ij} = F_{ij}(X_{1ij}, \ldots, X_{100ij}), \tag{7}$$

TABLE 5

INDUSTRY AND OCCUPATION DISTRIBUTION BY PERCENTILES, 1959–89

	PERCENTILES		
	0–10	45–55	90–100
Industry:			
Agriculture/mining	1.20	2.33	2.63
Construction	13.34	8.66	8.93
Manufacturing:			
Low-tech	9.03	2.75	1.87
Basic	11.85	17.26	10.18
High-tech	6.54	15.52	17.77
Commercial transportation and utilities	5.66	10.84	9.49
Wholesale	4.86	5.55	6.75
Retail	21.66	9.60	5.96
Professional services, finance, insurance, and real estate	9.91	8.58	21.90
Education and welfare	5.26	6.13	5.16
Public administration	2.56	10.02	7.75
Other service	8.14	2.75	1.62
Occupation:			
Professional/technical	5.19	15.27	31.11
Managers	5.09	12.71	38.64
Sales	4.99	5.29	8.88
Clerical	6.44	8.71	2.17
Craft	20.14	27.20	12.50
Operatives	20.37	14.18	2.36
Transportation operatives	8.94	6.69	2.35
Laborer	12.76	4.74	.69
Farm private household	.57	.09	.00
Service	15.52	5.13	1.30

where Y_{ij} is the output produced by industry/occupation cell ij, and F_{ij} is the corresponding production function giving output as a function of the number of workers from each percentile $(X_{1ij}, \ldots, X_{100ij})$. With constant returns to scale the dual of this problem is then

$$\mathbf{X}_{ij} = Y_{ij} \times \mathbf{D}_{ij}(W_1, \ldots, W_{100}), \tag{8}$$

where $\mathbf{X}_{ij}$ is the 100×1 vector of employment by percentile in industry/occupation cell ij, $\mathbf{D}_{ij}$ is the vector of unit demand functions for each percentile, and $W_1, \ldots, W_{100}$ are the wages at the different percentiles. The change in labor demand associated with a given change in the industrial and occupational structure is then

$$dX_d = \sum_{i,j} \frac{dY_{ij}}{Y_{ij}} \mathbf{X}_{ij}. \tag{9}$$

Empirically, we measure the change in output of an industry by occupation cell by the change in factor inputs at fixed reference prices (note that this also allows for factor-neutral technological change within industries and occupations) and measure $\mathbf{X}_{ij}$ by the employment distribution across industries and occupations by percentile over the entire sample. Demand growth for any group of workers is measured as a weighted average of the growth in factor inputs in industry/occupation cells; the weights are industry by occupation shares for that group. Therefore, groups employed largely in expanding sectors will experience rising demand, and groups employed largely in contracting sectors will have reduced demand. Changes in the coding of industries and occupations limit our ability to make these calculations for years prior to 1967, so we limit this analysis to the 1967–89 period and 1959.

Figure 9 graphs the percentage change in relative demand at each percentile of the overall wage distribution accounted for by shifts in employment across our industry and occupation categories for the whole period and three subperiods.[3] Panel A gives the change in demand over the full period, 1959–89. As the figure shows, demand fell by roughly 10 percent for workers below the median and increased by between 5 and 40 percent for workers in the top quartile. Since the demand shifts that can be proxied by our crude demand measures are likely to be a small part of the true change in demand, such large relative movements suggest a significant shift in favor of the most skilled. The remaining three panels compute demand

[3] Given the rapid rise in skill premia over the period, these "measured" demand shifts must understate the "true" changes in demand that would have occurred with fixed skill prices.

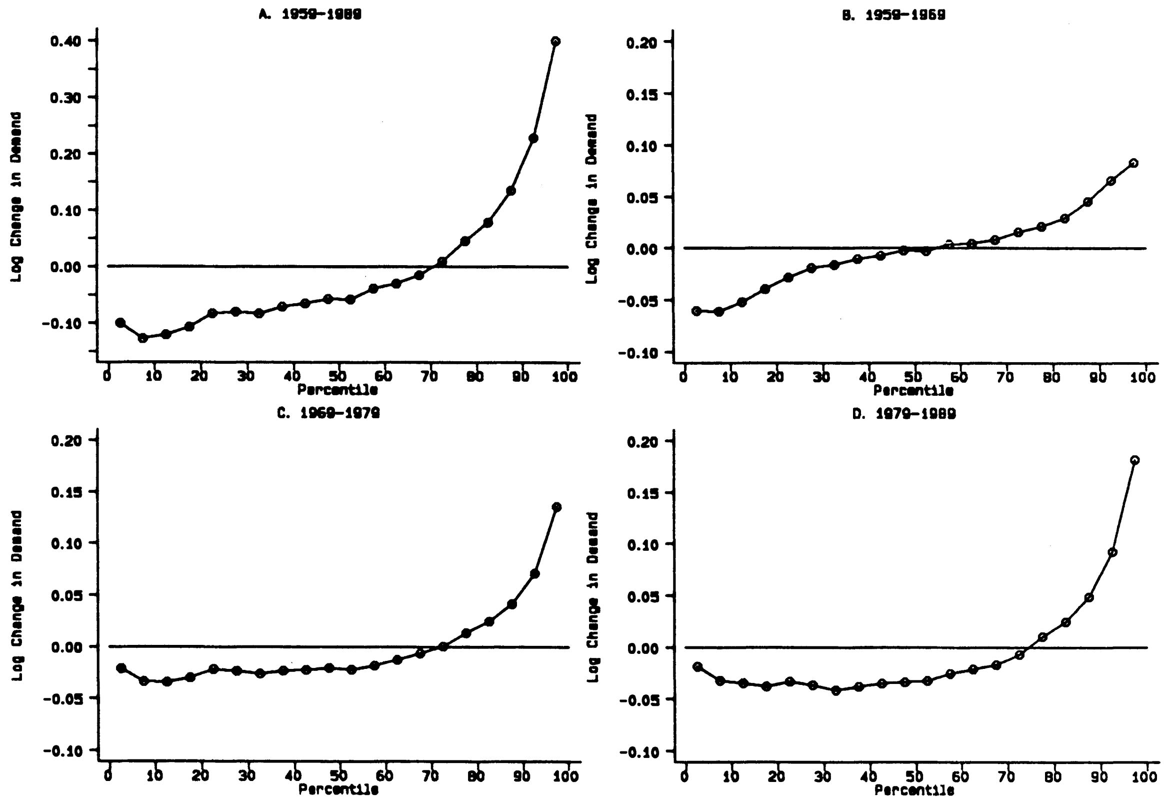

FIG. 9.—Changes in labor demand by wage percentiles

changes for three subperiods: 1959–69 (when skill premia showed little change) and 1969–79 and 1979–89 (when skill premia increased rapidly).

As can be seen in the figure, rising demand for skill has characterized the past three decades. The demand for skill increased over the 1960s (panel B), whereas skill premia did not change. In fact, the only real contrast in the later periods appears to occur at the highest percentiles, where demand growth accelerated from the 1960s to the 1970s and again from the 1970s to the 1980s. We interpret the four panels of figure 9 to show that growing demand for skill is an important factor leading to the growth in wage inequality over the past two decades (causing the demand for workers in the top decile to grow about 30–40 percent relative to the demand for workers in the lowest deciles). However, figure 9 also shows that growth in the demand for skill was not limited to these two recent decades. Unless wage inequality is particularly sensitive to demand shifts for the highest-decile workers, changes in demand growth as we have measured it here do not explain the contrast between the events of the 1960s and the two most recent decades.

The change in occupation and industry composition has been hypothesized to have had an effect on the wage structure quite separate from that described here. Some authors (Bluestone and Harrison 1988) and the popular press have emphasized the shift in industrial composition toward services and away from manufacturing as a shift toward low-wage jobs and a shift toward industries in which high-skilled or highly educated workers do well but less educated and less skilled workers do poorly. This alternative theory suggests that in fact wage inequality has risen as a result of a shift in employment toward low-wage jobs or a shift in employment toward both high- and low-wage jobs. The demand index numbers clearly reject the hypothesis that employment has shifted toward low-wage jobs but support the view of a shift toward high-wage jobs.

A direct way to evaluate these types of explanations is to look at a decomposition of the variance into within- and between-industry components (the same can be done by occupation or by both industry and occupation). The basic decomposition is that

$$\sigma_t^2 = \sum_i P_{it}\sigma_{it}^2 + \sum_i P_{it}(w_{it} - \overline{w}_t)^2, \tag{10}$$

where σ_t^2 is the variance of weekly wages in year t, P_{it} is the fraction of workers in industry i in year t, σ_{it}^2 is the variance of wages in industry i in year t, and w_{it} is the average log weekly wage in industry i in year t. The change in variance through time can then be decomposed into a shift in industry composition (i.e., a shift in the P_{it})

and shifts in within- and between-industry wage differences. The composition effects will raise the variance to the extent that employment shifts either toward industries with a high within-industry variance or toward industries with average wages very different from the mean. The skill price effects show up as either increases in wage inequality within an industry or increases in the wage differentials between industries.

Table 6 quantifies the total change in variance into four components for the period as a whole and for subperiods before and after 1979. For the full period, wage changes account for .142 out of the .158 change in variance. Of the remainder almost all of the change is accounted for by a shift to industries with a higher within-industry variance. The subperiods show a similar decomposition, with relative wage changes accounting for .048 of the total change of .054 for the 1967–79 period and .093 out of .104 for the 1979–89 period. These numbers would seem to imply that the shift in industrial composition has not had an important composition effect on the wage distribution. If the shift in industrial composition is important, it must have affected the returns to skill as emphasized by our demand shift theory. Our basic interpretation of these results and those in figure 9 is that the fall in wages for the least skilled is symptomatic of a fall in demand for low-wage workers and not a rise in the number of low-skilled jobs. There are simply too *few* low-wage jobs, to use the common jargon, and not too many, as previous authors have contended.

While the story of a rapid increase in the demand for skill offers some explanation for why skill premia are roughly 30–50 percent higher today than in 1963, it does not explain why the time series of skill prices are so different for education, experience, and within-group skill. One potential explanation for the returns to education story is that supply growth as well as demand growth has been an important factor in determining education returns. The first thing to note along these lines is that the supply of educated workers has increased enormously over the past two decades (increasing by

TABLE 6

EFFECTS OF INDUSTRIAL COMPOSITION ON WAGE INEQUALITY, 1967–89

		Within-Industry		Between-Industry	
Years	Total Change	Variance Changes	Composition Effect	Wage Changes	Composition Effect
1967–89	.158	.119	.015	.023	.001
1967–79	.054	.039	.006	.009	.000
1979–89	.104	.079	.009	.014	.001

roughly 100 percent). Given that wage premia have increased in spite of this enormous growth in supply, it seems clear that there must have been significant growth in the demand for education. One view for the fall in education returns over the 1970s and the subsequent rapid rise in the 1980s (suggested by Murphy and Welch [1989]) is that supply grew faster than demand over the 1970s and then slower than demand during the 1980s. Similarly, perhaps much of the increase in the returns to experience can be attributed to the arrival of the baby boom cohorts and the associated youthening of the labor force. However, as Katz and Murphy (1992) point out, this does not seem to be a sufficient explanation for the rapid rise in experience returns in the 1980s as the baby boom cohorts moved up in the age distribution.

A complete explanation of the economic phenomena behind the data we have described would appear to require at least two additional components. First, it seems clear from the data that the demand for skill has risen. Further research must identify the sources of this demand shift; likely but untested candidates are biased rates of technological progress and changes in the world economy. Also, an accurate description of the determinants of the timing in observable skill prices requires explicit consideration of supply and demand forces for the skill in question. Continued success in understanding the forces bringing about greater wage inequality hinges on the progress of future work in these areas.

VI. Wage Inequality versus Income Inequality

Our discussion to this point has focused on inequality in weekly and hourly wages. While this focus is probably correct for purposes of measuring the returns to skill, income rather than wage inequality has historically been more widely described and analyzed. Our purpose in this section is not to choose between these two concepts as measures of welfare or anything else but simply to show that empirically the two concepts are quite distinct. For our purpose here we focus on the contrast between inequality in annual earnings and inequality in weekly wages. Since annual earnings and weekly wages for an individual are much more closely linked than total family income (a common income measure) and weekly wages, any contrast we find here for weekly wages and annual earnings is likely to greatly understate the true income/wage distinction.

Panel A of figure 10 graphs the variance of log annual earnings for 1963–89 using the same CPS data used for our wage inequality calculations, except that we no longer exclude those working 1–13 weeks. As is clear from the figure, earnings inequality declined some-

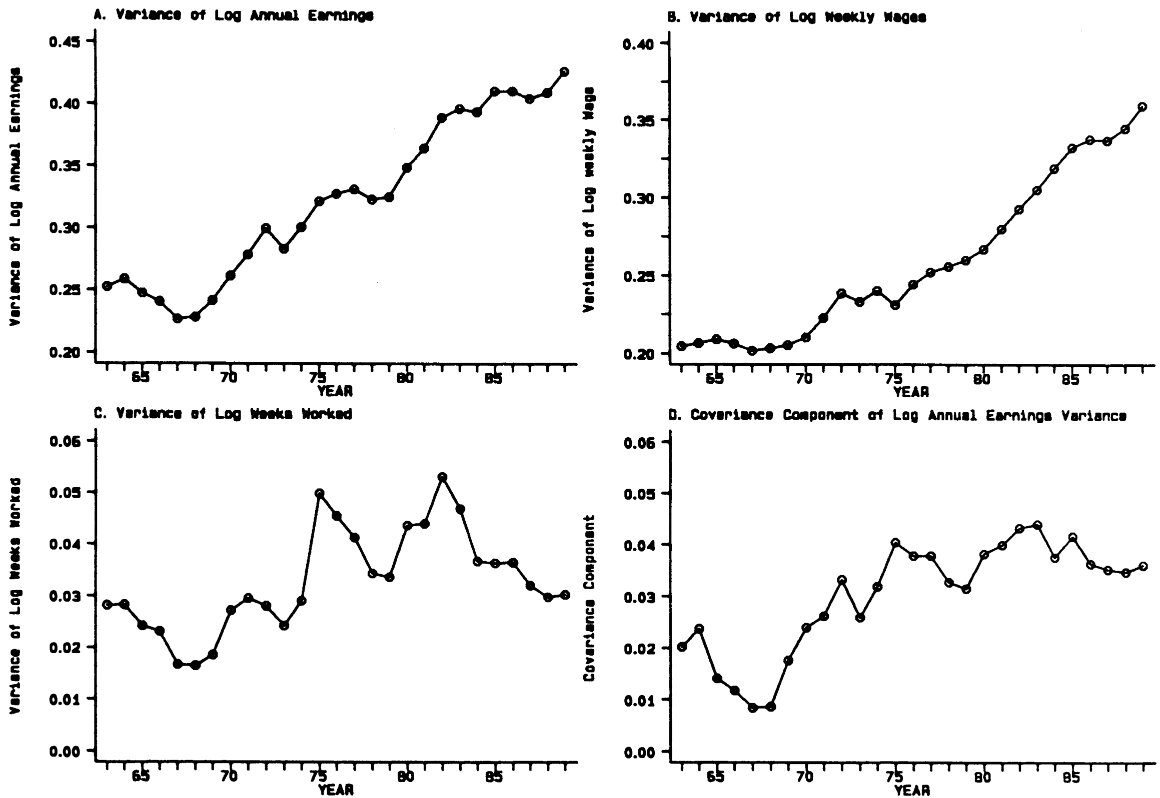

FIG. 10.—Log annual earnings variance and components, 1963–89

what from the mid-1960s through about 1968 and has increased significantly since. Business cycle swings are also clearly important, as evidenced by the large increases in inequality during the recessions of 1971, 1975, and 1982. Overall from 1968 through 1989 the variance of log earnings increased by about 80 percent (from .25 to .45). The remaining panels of the figure decompose this increase into the weeks worked variance, the weekly wage variance, and the covariance of weekly wages and weeks worked. Since annual earnings are simply the product of weeks worked and the weekly wage, we can write the log of annual earnings as

$$y = l + w, \tag{11}$$

where y is the log of annual earnings, l is the log of weeks worked, and w is the log weekly wage. Using this notation we can write the variance of log annual earnings, σ_y^2, as

$$\sigma_y^2 = \sigma_l^2 + \sigma_w^2 + 2\sigma_{lw}, \tag{12}$$

where σ_w^2 is the variance of log weekly wages, σ_l^2 is the variance of log weeks worked, and σ_{lw} is the covariance of log earnings and log weeks. The variance of weekly wages is shown in panel B of figure 10 and follows a pattern quite similar to the ninetieth-tenth percentile log wage differential shown in figure 7. The variance of weekly wages is very steady from 1963 through 1968 and then increases relatively smoothly from 1968 until 1986. In contrast, the variance of log weeks (panel C) shows a distinct cyclic pattern, with sharp rises in 1970–71, 1975, and 1982. This cyclic pattern results from the fact that reductions in annual hours are very unevenly distributed across workers (i.e., relatively few workers work many fewer weeks).

The covariance term in panel D reflects the growing positive association between wages and time worked. As two of us have found in our other work (Juhn, Murphy, and Topel 1991; Juhn 1992), this strengthening of the cross-sectional labor supply relationship occurs mostly prior to 1975, after which the relationship is relatively stable. Over the period as a whole, the increase in the weekly wage variance accounts for about .14 of the overall .18 increase in the annual earnings variance. The remainder is attributable to the increased variance of weeks worked and a small rise in the covariance of weekly wages and weeks worked.

We stress the need to distinguish between the earnings and wage inequality concepts. For example, because of the highly cyclic pattern of weeks worked, the variance of log annual earnings is actually lower in 1989 than in 1982, whereas the variance of weekly wages is actually about 20 percent higher in 1989 than in 1982. As measured by the variance of log annual earnings, inequality is lower now than in 1982, but as measured by weekly wages, it is significantly higher. This striking example serves as a warning to keep in mind which inequality concept is of interest for a particular problem.

VII. Conclusion

In this paper we have identified the enormous increase in wage inequality among male workers over the past two decades. The trend toward greater wage inequality is attributable primarily to increases in the premia on both unobserved and observed (such as education) dimensions of skill, with the majority of the increase over the period due to the unobserved component. We also show that the timing of the increased premium on the unobserved components of skill differs from the timing of changes in the skill premia on education and labor market experience. In particular, returns to unobservable skills have shown a steady increase since 1970.

Our basic rationale for this increase is the rapid growth in demand for skilled workers. While it seems clear that skill premia have risen and hence that the demand for skill has risen as well, the exact source of this demand increase is as yet unknown; likely candidates are biased rates of technological progress and changes in the world economy. We feel that further progress in comprehending the increases in wage inequality documented here will require a greater understanding of these fundamental underlying forces.

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