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Source: *The Quarterly Journal of Economics*, Feb., 1992, Vol. 107, No. 1 (Feb., 1992), pp. 35-78

Published by: Oxford University Press

Stable URL: https://www.jstor.org/stable/2118323

CHANGES IN RELATIVE WAGES, 1963–1987: SUPPLY AND DEMAND FACTORS*

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A simple supply and demand framework is used to analyze changes in the U. S. wage structure from 1963 to 1987. Rapid secular growth in the demand for more-educated workers, "more-skilled" workers, and females appears to be the driving force behind observed changes in the wage structure. Measured changes in the allocation of labor between industries and occupations strongly favored college graduates and females throughout the period. Movements in the college wage premium over this period appear to be strongly related to fluctuations in the rate of growth of the supply of college graduates.

I. INTRODUCTION

Wage inequality among both men and women increased substantially in the United States during the 1980s. Changes in the wage structure along three primary dimensions played an important role in rising inequality. First, there was an increase in wage differentials by education with a particularly sharp rise in the relative earnings of college graduates. Second, the average wages of older workers increased relative to the wages of younger workers for those with relatively low levels of education. The combination of these two changes generated an increase in the weekly wages of young male college graduates by approximately 30 percent relative to young males with twelve or fewer years of schooling from 1979 to 1987. Third, earnings inequality also increased greatly within narrowly defined demographic and skill groups. Although the male and female wage structures widened considerably, differences in earnings between men and women narrowed throughout the 1980s. The average wage of women increased by about 8 percent relative to the average wage of men from 1979 to 1987.

Although the pattern of movements in the U. S. wage structure in the 1980s is well documented,[1] much disagreement remains concerning the fundamental causes of the changes. Several explana-

*We thank John Bound, Richard Freeman, Claudia Goldin, Lawrence Summers, Finis Welch, and participants at several seminars and NBER conferences for helpful comments. We are also grateful to Chinhui Juhn, Brooks Pierce, and Boris Simkovich for expert research assistance. Financial support was provided by NSF Grant No. SES-9010759. The final data sets used in this paper are available upon request.

1. See, for example, Blackburn, Bloom, and Freeman [1990]; Bound and Johnson [1992]; Juhn, Murphy, and Pierce [1989]; Karoly [1990]; Katz and Revenga [1989]; Levy and Murnane [1991]; and Murphy and Welch [1992].

The Quarterly Journal of Economics, February 1992

tions have received much attention. One class of explanations postulates that changes in the U. S. wage structure during the 1980s are driven primarily by shifts in the relative demand for labor favoring more-educated and "more-skilled" workers over less-educated and "less-skilled" workers and favoring females over males. One variant emphasizes technological changes (possibly associated with the computer revolution) that are likely to have raised the relative demand for more-educated and flexible workers and reduced the demand for physical labor [Davis and Haltiwanger, 1991; Krueger, 1991; Mincer, 1991]. A second hypothesizes that shifts in product demand largely associated with large trade deficits in the 1980s have led to a sharp decline in manufacturing employment and a shift in employment toward sectors that are education and female intensive [Murphy and Welch, 1991]. Alternative explanations focus on changes in wage-setting institutions such as the decline in unions [Freeman, 1991], changes in pay norms [Mitchell, 1989], and the erosion of the real value of the minimum wage [Blackburn, Bloom, and Freeman, 1990].

In this paper we examine how far one can go toward explaining recent changes in relative wages in the United States using a simple supply and demand framework. Rather than focusing on changes in relative wages during the 1980s in isolation, we analyze relative wage movements over the longer 25-year time period from 1963 to 1987. By examining this longer time period, we are able to evaluate the ability of competing explanations to explain a wide range of wage observations (such as both falling college wage premiums in the 1970s and rising college wage premiums in the 1980s) as well as differences in timing in changes in wage differentials.

The paper is organized as follows. Section II describes the data from the March Current Population Surveys that we use throughout the paper. Section III uses these data to describe the basic patterns of change in real and relative wages in the United States over the 1963 to 1987 period. Section IV outlines the simple factor demand model that we use to interpret these relative wage data and evaluates the ability of simple demand shift stories to explain the observed patterns of changes in relative factor prices and supplies. Section V expands the basic model to incorporate both within- and between-industry components of relative factor demands. Section VI uses the basic framework to examine changes in education and experience differentials. Section VII summarizes our conclusions.

We conclude that rapid secular growth in the relative demand for "more-skilled" workers is a key component of any consistent explanation for rising inequality and changes in the wage structure over the last 25 years. Although much of this shift in relative demand can be accounted for by observed shifts in the industrial and occupational composition of employment toward relatively skill-intensive sectors, the majority reflects shifts in relative labor demand occurring within detailed sectors. These within-sector shifts are likely to reflect skill-biased technological changes. Differences in the time pattern of rising education differentials and rising within-group inequality suggest that they are distinct phenomena. Our results indicate that observed fluctuations in the rate of growth of the relative supply of college graduates combined with smooth trend demand growth in favor of more-educated workers can largely explain fluctuations in the college/high school differential over the 1963–1987 period. Steady demand growth in favor of more highly-skilled workers over the last twenty years appears consistent with both movements in education differentials and within-group inequality.

II. The Data

The data we use in this paper come from a series of 25 consecutive March Current Population Surveys (CPSs) for survey years 1964 to 1988. These CPS data are from the March Annual Demographic Supplement and provide information on earnings and weeks worked in the calendar year preceding the March survey. These surveys provide wage and employment information on approximately 1.4 million workers for the 1963 to 1987 period. From these CPS data we create two samples: (1) a wage sample that we use to measure weekly wages of full-time workers by demographic group and (2) a count sample that we use to measure the amount of labor supplied by each of these demographic groups. The taxonomy we use divides the data into 320 distinct labor groups, distinguished by sex, education (less than 12, 12, 13–15, and 16 or more years of schooling), and 40 single-year potential experience categories (corresponding to the first 40 years since the estimated age of labor market entrance).[2]

2. Potential experience is calculated as min(age − years of schooling − 7, age − 17) where age is the age at the survey date.

The wage measure that we use throughout the paper is the average weekly wage of full-time workers (computed as total annual earnings divided by total weeks worked) within a gender-education-experience cell.[3] Our wage sample includes full-time wage and salary workers who participated in the labor force for at least 39 weeks in the calendar year prior to the March survey, worked at least one week, and did not work part year due to school, retirement, or military service. Self-employed workers and those working without pay were excluded from the wage sample. The sample includes individuals for whom the Census imputed wages but makes a correction for the fact that the imputation procedures changed between the 1975 and 1976 March CPS surveys.[4] Workers with top coded earnings were imputed annual earnings at 1.45 times the annual topcode amount. This correction is based on our estimates of the conditional average earnings of those with earnings above the topcode. In addition, we excluded workers with real weekly earnings below $67 in 1982 dollars (equal to one half of the 1982 real minimum wage based on a 40-hour week). As best as we can ascertain from experimentation, our results are not highly sensitive to these exclusion criteria.

The count sample includes all individuals who worked at least one week in the preceding year (regardless of whether they were wage and salary workers, self employed, or otherwise). We compute total hours worked for each cell in each year by computing the product of total annual hours (weeks worked times usual weekly hours) and the individual CPS sample weight for each individual in

3. Weeks worked are available only on a bracketed basis for survey years prior to 1976. To impute weeks worked for the 1964–1975 surveys, we divided the wage sample for the later survey years into cells defined by the weeks worked brackets used in the earlier surveys and sex. We used the means of weeks worked for these cells from the 1976–1988 surveys as our estimates of weeks worked for individuals in the corresponding cells in the earlier surveys.

4. The Census began using a finer classification of observables to impute wages for workers who failed to report wages in the 1976 survey. Since information on which workers had imputed wages is not available for the years 1963–1966, one cannot construct a wage series using only workers without imputed wages for our entire sample period. To adjust group average wages for changes in the imputation procedures, we multiplied the average wages in each cell for the years 1963–1975 by a time-invariant, cell-specific adjustment factor. The adjustment factors were picked to impose the condition that the average percentage wage difference between the wages of all workers and those of workers without wage imputations were the same in the 1967–1975 and 1975–1987 periods. Our qualitative findings for the 1967–1987 period are quite similar when we use our adjusted series including workers with imputed wages and when we use only workers without wage imputations. See Lillard, Smith, and Welch [1986] for a discussion of the changes in techniques to impute missing data implemented with the 1976 survey.

the cell and then summing over all the individuals in the cell.[5] We use these total hours measures as estimates of the total labor supplied to the U. S. market by individuals with given characteristics. The total hours calculations for each cell are then deflated by the sum of total hours worked over all cells so that hours for each cell in each year are expressed as a fraction of total annual hours that year.

The use of two separate samples, one for measuring supplies and one for measuring prices, reflects the different criteria each sample must meet. The primary concern with the wage sample is to obtain data on a group that maintains a reasonably constant composition through time thus providing estimates of the prices received by workers of given skills. In this regard, our goal was to maximize the comparability through time. This is why we tried to focus on full-time workers with reasonably strong labor force attachment. For purposes of computing supply, the desire for homogeneity is overridden by the requirement of measuring an aggregate quantity.

Our wage data can be summarized by the (320×25) matrix W which contains the average weekly wage from the wage sample for each of our 320 groups in each year from 1963 to 1987. When we describe wages for more aggregated groups, we use a fixed-weight aggregation scheme where the fixed weights are given by the 320-element vector of average employment shares over the 1963 to 1987 period which we denote N. In addition, we use this same vector of fixed-weights to construct wage indices for each year as $N'W$. Deflating wages in each year by the value of this index for the year generates a time series of relative wages by groups (where each group's wage is indexed to the wages for a fixed bundle of workers). The average of these relative wages through time provides an estimate of the average relative wage of a given group and hence provides a natural basis for aggregating quantities of labor supplied across groups in terms of *efficiency units*. Accordingly, when we measure quantities of labor in efficiency units, we compute more aggregate supplies from the individual cell supplies

5. Total hours worked for group j in year t is given by $\Sigma_i h_{ijt} \omega_{ijt}$, where i indexes individuals, h is annual hours worked, and ω is the CPS sample weight. Usual weekly hours for the previous year are only available in the CPS since 1976. For survey years 1964–1975 we use hours worked during the survey week to measure usual weekly hours in the previous year. For individuals who did not work during the survey week, we imputed usual weekly hours using the mean of hours worked last week for individuals of the same sex and same full-time/part-time status who reported hours worked last week on that year's survey.

TABLE I
U. S. REAL WEEKLY WAGE CHANGES FOR FULL-TIME WORKERS, 1963–1987[a]

Group	Change in log average real weekly wage (multiplied by 100) 1963–1971	1971–1979	1979–1987	1963–1987
All	19.2	−2.8	−0.3	16.1
Gender:				
Men	19.7	−3.4	−2.4	13.9
Women	17.6	−0.8	6.1	22.9
Education (years of schooling):				
8–11	17.1	0.3	−6.6	10.9
12	16.7	1.4	−4.0	14.1
13–15	16.4	−3.4	1.5	14.4
16+	25.5	−10.1	7.7	23.1
Experience (men):				
1–5 years	17.1	−3.5	−6.7	6.8
26–35 years	19.4	−0.6	0.0	18.8
Education and Experience (men):				
Education 8–11				
Experience 1–5	20.5	1.5	−15.8	6.2
Experience 26–35	19.3	−0.4	−1.9	17.0
Education 12				
Experience 1–5	17.4	0.8	−19.8	−1.6
Experience 26–35	14.3	3.2	−2.8	14.7
Education 16+				
Experience 1–5	18.9	−11.3	10.8	18.4
Experience 26–35	28.1	−4.0	1.8	25.9

a. The numbers in the table represent log changes in mean weekly wages using data from the March Current Population Surveys for 1964–1988. Mean weekly wages for full-time workers in each of 320 sex-education-experience cells were computed in each year. Mean wages for broader groups in each year represent weighted averages of these cell means using a fixed set of weights (the average employment share of the cell for the entire 1963–1987 period). All earnings numbers are deflated by the implicit price deflator for personal consumption expenditures.

by weighting hours worked in each cell contained in the aggregate by the average relative wage of that cell and summing.

III. REAL AND RELATIVE WAGE CHANGES, 1963–1987

Table I describes changes in the real weekly wages of the full labor force and of individual demographic groups for the 1963–1987 period and for three periods, 1963–1971, 1971–1979, and 1979–1987.[6] Over the entire period average real weekly wages

6. We compute real wages by deflating nominal wages in each year by the implicit price deflator for personal consumption expenditures from the National Income and Product Accounts.

increased by 16.1 percent.[7] This growth in real wages breaks down into a 19.2 percent increase between 1963 and 1971 and small declines during the 1971–1979 and 1979–1987 subperiods. The major difference between these computations and more standard measures of average real wages is that the measures in Table I refer to wages for a fixed demographic distribution (the average employment distribution over the 1963 to 1987 period) and hence do not reflect changes in the level of wages arising from shifts in the education, gender, or experience composition of the labor force.

The next two rows of the table indicate that wages of women increased by 9 percent relative to the wages of men over the entire period. This reduction in the overall gender gap in earnings was concentrated in the 1980s. In fact, the earnings of women increased relative to those of men in almost all experience-education cells during the 1980s. Panel A of Figure I contrasts the time pattern of changes in the female/male wage ratio for high school and college graduates from 1963 to 1987.[8] Although the narrowing of the gender gap in wages started earlier for college graduates than for high school graduates, the increase in the female/male wage ratio is much more substantial in the 1980s for high school graduates.

The next four rows of Table I show real wage changes by education level. For the full period, real wage changes are monotonically increasing in education level, reflecting a rise in education-based wage differentials. The timing of the growth in education returns is very uneven, however. From 1963 to 1971 college graduates gained about 8 percent on other groups. Between 1971 and 1979 real wages fell the most for college graduates, by 10.1 percent, and actually increased slightly for the two least-educated groups. In contrast, from 1979 to 1987 college graduates gained 14.1 percent on high school dropouts and 11.7 percent on high school graduates. Since these changes more than make up for the decline in the relative wages of college graduates over the 1970s, the college wage premium was higher in the late 1980s than at any

7. We refer to 100 times log changes as percentage changes in this section.

8. The female/male wage ratios reported in the figure are computed by first sorting the data into cells defined by education level and five-year potential experience intervals. The reported female/male wage ratios are fixed-weighted averages of the ratios of the average weekly wage of females to the average weekly wage of males in each cell where the fixed weight for each cell is the cell's average share of total employment over the entire 1963–1987 period. The wage ratios reported in the other panels of Figure I are analogous fixed-weighted averages of wage ratios for cells defined by gender, education level, and five-year experience interval.

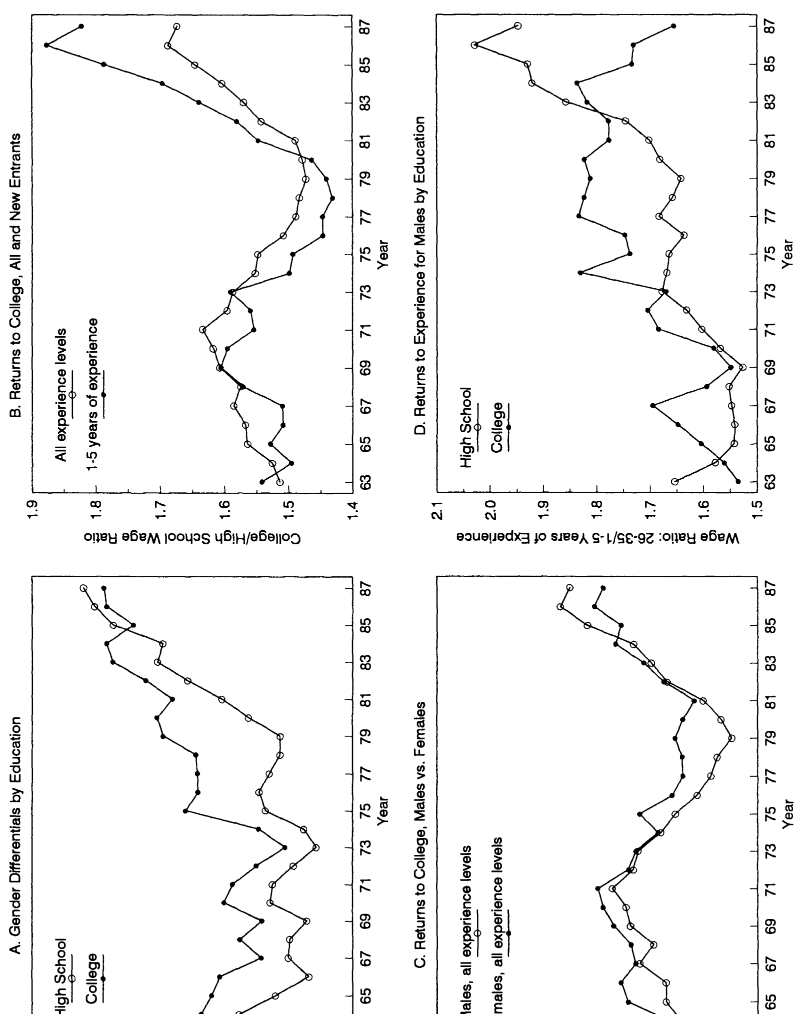

FIGURE I
Major U. S. Relative Wage Changes, 1963–1987

other time during our sample and most likely at any other time during the postwar period [Goldin and Margo, 1992].

Panels B and C of Figure I further illustrate changes in the earnings of college graduates relative to high school graduates. Panel B documents movements in the fixed-weighted average college/high school wage ratio for all workers and for workers with one to five years of experience. The figure highlights much larger swings in educational differentials for young workers than for older workers in the 1970s and 1980s. In fact, the college/high school wage ratio for young workers fell from 1.61 in 1969 to 1.44 in 1979 and then increased sharply to 1.82 in 1987. Panel C shows that fluctuations in the college wage premium were quite similar for men and women.

The next two rows of Table I examine real wage changes by experience level for males. Over the entire sample period the wage gap between older and younger workers expanded with peak earners, those with 26 to 35 years of experience, gaining 12 percent on new entrants, those with 1 to 5 years of experience. Although experience differentials for men expanded throughout the period, they increased most substantially during the 1980s.

The final rows of Table I present real wage movements for education by experience cells for males. Two distinct patterns emerge. First, high school graduates and high school dropouts show the largest increases in experience differentials (16.3 and 10.8 percent, respectively) and for both groups this increase is accounted for entirely by the rise in experience returns in the final time interval. For college graduates the time series of experience returns is quite different. Experience differentials increase sharply in both of the first two time intervals so that from 1963 to 1979 experienced college graduates gained 16.5 percent on new entrants. However, during the 1980s the relative wages of young college graduates increased sharply. The differences in the patterns of changes in experience differentials for high school and college graduates are graphed in Panel D of Figure I.

We have so far referred to changes in real wages for groups distinguished by sex, education, and experience. However, given that these factors account for only about one third of the differences in wages across workers, there is significant room for relative wage changes within these categories as well. We use the dispersion of relative wages within our gender-education-experience cells as a measure of the spread in relative wages across different skill levels within the cells. Empirically we do this by looking at the distribution of residuals from a regression of log weekly wages on a quartic in experience fully interacted with sex and four education-level dummies, and linear terms in education within these categories. The distribution of residuals from this regression essentially captures the dispersion of wages within the demographic groups.

We summarize these results in panel A of Figure II where we plot the differences in the log wage residuals of those at the ninetieth and at the tenth percentiles of the distribution of log wage residuals for men and women. Within-group (residual) wage inequality has expanded enormously for both women and men from 1963 to 1987. The log wage gap between the ninetieth and tenth percentile worker within experience-education groups increased by approximately 0.26 for men and 0.21 for women from 1963–1987. This striking increase in wage inequality within groups means that not only have the less-educated and less-experienced workers lost out over our sample period but so too have the "least-skilled" or "least-lucky" workers within each category.

An examination of the time series displayed in Panel A of Figure II shows that residual inequality started to expand in the early 1970s and continued increasing rather smoothly in the 1980s. This time pattern contrasts sharply with the pattern for education differentials. We conclude from these differences in timing that the general rise in within-group inequality and the rise in education premiums over the 1963–1987 period are actually somewhat distinct economic phenomena. The earlier increase in within-group inequality suggests a rise in the demand for "skill" that predates the recent rise in returns to education.

We next examine changes in overall wage inequality by sex. Panel B of Figure II plots movements in overall wage dispersion as measured by the log wage differential between workers at the ninetieth and tenth percentiles of the wage distribution for men and for women. The 90-10 log wage differential for males remained stable in the 1960s, increased substantially from 1.18 in 1970 to 1.29 in 1979, and then expanded sharply by 0.18 log points from 1979 to 1987. Wage inequality for females remained fairly stable in the 1960s and 1970s, and then increased sharply from 1.08 in 1979 to 1.32 in 1987. The log wage gap between the ninetieth and tenth percentile workers increased by 0.26 for men and by 0.25 for women from 1963 to 1987. The pattern of changes in overall wage inequality over our sample period is quite similar if one uses alternative summary measures such as the variance of log wages,

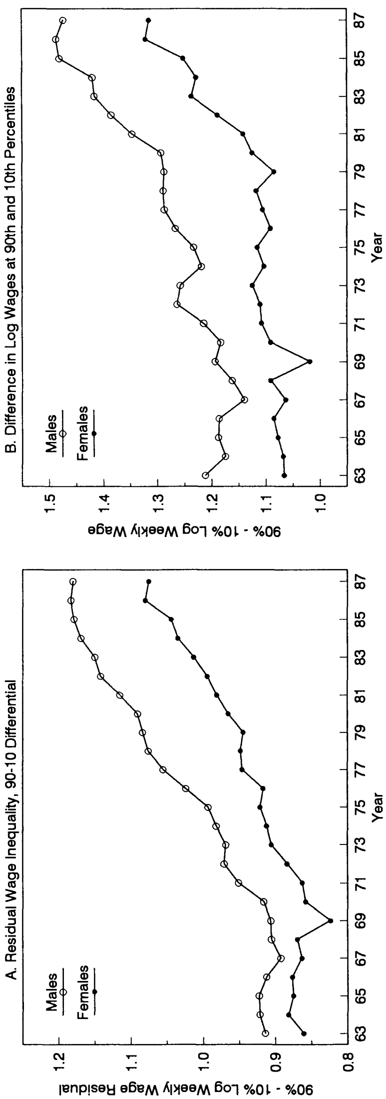

FIGURE II
Changes in Overall and Residual Wage Inequality

the interquartile range, or a gini coefficient [Juhn, Murphy, and Pierce, 1989; Karoly, 1990; Levy and Murnane, 1991]. In fact, the weekly and hourly wage distributions for both men and women appear to have spread out fairly evenly across all percentiles from 1963 to 1987.

We conclude that all major relative wage differentials with the exception of the male/female differential increased from 1963 to 1987. These basic changes in the U. S. wage structure can be summarized as follows.

1. The college wage premium rose from 1963 to 1971, fell from 1971 to 1979, and then rose sharply from 1979 to 1987. The changes in the college/high school wage ratio were greatest for the youngest workers in the 1970s and 1980s and greatest for prime age workers in the 1960s.

2. Experience differentials expanded substantially from 1963 to 1987. The most dramatic increases in experience differentials occurred for less-educated males from 1979–1987.

3. Overall and residual weekly wage inequality for both men and women (as measured by the 90-10 log wage differential) were stable during the 1960s and then increased by almost 30 percent from the late 1960s to 1987. The increase in residual inequality has been quite steady since the early 1970s, while the growth in overall inequality accelerated in the 1980s.

4. After remaining fairly stable in the 1960s and 1970s, male/female wage differentials narrowed substantially from 1979 to 1987.

IV. A Simple Supply and Demand Framework

We begin our examination of the between-group relative wage changes documented in the previous section using a simple supply and demand framework in which different demographic groups (identified by sex, education, and experience) are treated as distinct labor inputs. We think of the relative wages of demographic groups as being generated by the interaction of the relative supplies of the groups and an aggregate production with its associated factor demand schedules. To the extent that these different demographic groups are imperfect substitutes in production, we can view changes in relative wages as being generated by shifts in relative supplies and shifts in the factor demand schedules. The framework is distinctly partial equilibrium in that we do not specify the determinants of relative factor supplies. We only require that observed prices and quantities must be "on the demand curve."

A. The Basic Framework

Our basic framework involves an aggregate production function consisting of K types of labor inputs. We assume that the associated factor demands can be written as

$$X_t = D(W_t, Z_t), \tag{1}$$

where

$X_t = K \times 1$ vector of labor inputs employed in the market in year t

$W_t = K \times 1$ vector of market prices for these inputs in year t

$Z_t = m \times 1$ vector of demand shift variables in year t.

The demand shifters Z_t reflect the effects of technology, product demand, and other nonlabor inputs on demands for labor inputs.

Under the assumption that the aggregate production function is concave, the $(K \times K)$ matrix of cross-price effects on factor demands, D_w, is negative semidefinite. Equation (1) can be written in terms of differentials as

$$dX_t = D_w dW_t + D_z dZ_t. \tag{2}$$

The negative semidefiniteness of D_w implies that

$$dW_t'(dX_t - D_z dZ_t) = dW_t' D_w dW_t \leq 0. \tag{3}$$

Changes in factor supplies (net of demand shifts) and changes in wages must negatively covary.

One hypothesis that has attracted much attention in previous related research (e.g., Freeman [1979] and Welch [1979]) is whether shifts in relative supplies are the driving force behind observed changes in relative wages. A test of an extreme version of this hypothesis is to examine whether the data are consistent with stable factor demand. In this case, wage changes are generated by relative supply changes arising from changing demographics and school completion rates. In the case of two inputs the basic implication of stable relative factor demand is that an increase in the relative supply of a group must lead to a reduction in the relative wage of that group. More generally, if factor demand is stable (Z_t fixed), equation (3) implies that $dW_t' dX_t \leq 0$. We use our estimates of the time series, (X_t, W_t), $t = 1963, \ldots, 1987$, and a discrete version of this equation to test for stable demand. Specifically, we test for fixed factor demand between the year t and year τ by evaluating whether

$$(W_t - W_\tau)'(X_t - X_\tau) \leq 0. \tag{4}$$

This inequality provides a natural way in which to evaluate the pure supply shifts story. Periods of time in which the inequality in (4) is satisfied (i.e., the inner product of changes in wages and changes in factor supplies is nonpositive) have the potential to be explained solely by supply shifts. When this inequality is not satisfied, no story relying entirely on supply shifts is consistent with the data. In this case, we can evaluate alternative hypotheses concerning relative demand shifts (alternative proxies for Z_t) using the discrete version of (3) given by

$$(5) \qquad (W_t - W_\tau)'[(X_t - X_\tau) - (D(W_\tau, Z_t) - D(W_\tau, Z_\tau))] \leq 0,$$

where we compute the inner product of the change in wages from year τ to year t with the changes in net supplies (equal to the actual change in supply less the change in demand for X that would have happened at fixed factor prices).

In our implementation of this framework, we are concerned with explaining *relative* wage changes as a function of *relative* supply and *relative* factor demand shifts. We abstract from changes in absolute wages arising from factor-neutral technological change and from neutral demand shifts associated with changes in the scale of the economy. To do so, we use a relative wage measure (actual wages W_t deflated by the wage index $N'W_t$, where N is the $(K \times 1)$ vector of average employment shares over the entire sample for the K labor inputs) and a relative supply measure (actual supplies X_t deflated by the total supply of labor in the economy measured in efficiency units $\Omega'X_t$, where Ω is the $(K \times 1)$ vector of average relative wages over the entire sample) when we empirically evaluate (4) and (5).[9]

9. The use of these relative wage and quantity measures can be formally justified as follows. We first assume that the aggregate production function can be written as $y_t = \phi_t F(X_t)$ where ϕ_t indexes the state of technology of the economy and $F()$ is concave. The concavity of $F()$ implies that

$$[F_x(X_t) - F_x(X_\tau)]'(X_t - X_\tau) \leq 0,$$

where F_x is the $K \times 1$ vector of derivatives of F with respect to the K inputs. Under the assumption that marginal products are set equal to factor prices, we have $W_t = \phi_t F_x(X_t)$ for all t so that the inequality can be rewritten as

$$[(W_t/\phi_t) - (W_\tau/\phi_\tau)]'(X_t - X_\tau) \leq 0.$$

If we further assume that there are constant returns to scale in production so that $F()$ is a linear homogeneous function, then $F_x(k_t X_t) = F_x(X_t)$ for any scalar k_t. Thus, $W_t = \phi_t F_x(k_t X_t)$ and $W_\tau = \phi_\tau F_x(k_\tau X_\tau)$ for any scalars k_t and k_τ. This implies that the inequality,

$$[(W_t/\phi_t) - (W_\tau/\phi_\tau)]'(k_t X_t - k_\tau X_\tau) \leq 0,$$

also holds for any scalars k_t and k_τ. This final inequality is the form of (4) that we use in our empirical tests. We approximate the level of productivity at time t, ϕ_t, using the value of our wage index $N'W_t$, and we multiply the factor quantities X_t in year t by one over the total supply in efficiency units.

B. Relative Supply Changes

Table II summarizes changes in relative factor supplies (where each group's supply is measured relative to the total supply in efficiency units) over the 1963–1987 period and the subperiods 1963–1971, 1971–1979, and 1979–1987 for the same aggregates used to analyze changes in wages in Table I. The table illustrates that there has been substantial long-run growth in the relative supply of more-educated workers, younger workers, and women. The increase in the average educational attainment of the labor force is particularly striking. The share of aggregate hours worked contributed by college graduates increased from 13.0 to 26.3

TABLE II
RELATIVE SUPPLY CHANGES, 1963–1987[a]

Group	Change in log share of aggregate labor input (multiplied by 100) 1963–1971	1971–1979	1979–1987	1963–1987
Gender:				
Men	−2.9	−4.9	−4.2	−12.0
Women	11.2	15.7	11.2	38.2
Education (years of schooling):				
8–11	−35.2	−48.6	−41.9	−125.7
12	7.6	−4.8	−4.8	−2.0
13–15	20.3	23.3	6.7	50.3
16+	17.8	24.1	15.6	57.5
Experience (men):				
1–5 years	30.3	16.3	−27.9	18.6
6–10 years	14.2	19.5	−10.4	23.4
11–15 years	−4.3	6.9	17.5	20.1
16–20 years	−17.8	−6.6	22.7	−1.7
21–25 years	−15.5	−16.9	0.0	−32.3
26–35 years	−5.5	−23.8	−17.4	−46.7
Experience and education (men):				
Education 8–11				
Experience 1–5	−21.1	1.5	−53.3	−72.9
Experience 26–35	−34.8	−59.8	−65.3	−159.8
Education 12				
Experience 1–5	16.2	18.7	−40.9	−6.0
Experience 26–35	4.0	−26.9	−10.9	−33.8
Education 16+				
Experience 1–5	52.7	17.1	−12.7	57.1
Experience 26–35	19.8	18.9	−5.8	32.9

a. The numbers in the table represent log changes in each group's share of total labor supply measured in efficiency units (annual hours times the average relative wage of the group for the 1963–1987 period) using data from the March Current Population Surveys for 1964–1988. Supply measures include all workers in the count sample described in the text.

percent from 1963–1987, while the share for high school dropouts fell from 39.2 to 12.6 percent over the same period. Since the relative supplies and wages of more-educated workers and women increased over the sample, relative demand changes favoring these groups are necessary to explain the observed data.

On the other hand, the table does illustrate the possibility that differences in the rate of growth in the relative supply of college graduates may help explain the time pattern of changes in the college wage premium. The largest increase in the supply of college graduates comes during the 1971–1979 period in which the college wage premium declined, and the smallest growth of supply comes during the 1979–1987 period in which the college wage premium expanded sharply. A smooth secular increase in the relative demand for college graduates combined with the observed fluctuations in the rate of growth of relative supply could potentially explain the movements in the college wage premium from 1963 to 1987.

An analogous story emphasizing smooth trend growth in the relative demand for women and relative supply growth variation seems less likely to provide a complete story for changes in the gender gap in earnings. The rate of growth of the share of the labor force accounted for by women is more rapid in the 1970s than in the 1960s or 1980s. The deceleration in the rate of growth of female labor supply in the 1980s combined with a secular growth in the relative demand for industries and occupations in which women have been concentrated may help explain the greater earnings gains made by women in the 1980s than in the 1970s. On the other hand, the acceleration in the growth rate of relative supply from the 1960s to the 1970s bodes poorly for an explanation based on supply growth fluctuations since the relative earnings of women declined in the 1960s.

Changes in the age structure of the labor force may be an important part of an explanation for secular increases in the relative earnings of older workers. The share of labor supply (measured in efficiency units) accounted for by workers with one to ten years of experience increased rapidly from 18.9 percent in 1963 to a peak of 30.8 percent in 1980 and then decreased to 27.4 percent in 1987. The secular increase in the share of young workers consisted of dramatic increases in the relative supply of new entrants from the mid-1960s to the late 1970s as the baby boom cohorts entered the labor force combined with a sharp decline in the share of new entrants in the 1980s with the passage of the baby boom cohorts into mid-career. This pattern of changes in relative supplies can help explain increases in experience differentials in the 1970s, but it has some difficulties with the sharp increases in experience differentials for less-educated males in the 1980s.

C. Can Relative Supply Changes Explain Relative Wage Changes?

To more formally examine how relative supply changes line up with the relative wage changes, we implement the framework outlined above. For the analysis in this section we divide our data into 64 distinct labor groups, distinguished by sex, 4 education categories (8–11, 12, 13–15, and 16+ years of schooling), and 8 experience categories (1–5, 6–10, 11–15, 16–20, 21–25, 26–30, 31–35, and 36–40 years). We begin with equation (4) and compute the inner products of changes in relative wages with changes in relative factor supplies between time periods. To reduce the number of computations and minimize the impact of measurement error, we aggregate our 25 years into 5 five-year intervals and compute average relative wages (relative to our wage index) and average relative supplies for each of our 64 groups within these subperiods. We then compute the inner products of the changes in these measures of wages and supplies between each pair of these five intervals.

The results of these calculations are given in the top part of Table III. The data appear to be reasonably consistent with the stable demand hypothesis for the 1965–1980 period. Five of the six

TABLE III
INNER PRODUCTS OF CHANGES IN RELATIVE WAGES WITH CHANGES IN RELATIVE QUANTITIES FOR 64 DEMOGRAPHIC GROUPS

5-year centered interval	5-year centered interval			
	1965	1970	1975	1980
Inner products of actual changes:				
1970	0.0128			
1975	−0.1129	−0.1084		
1980	−0.0893	−0.1605	−0.0040	
1985	0.3813	0.1704	0.2224	0.1421
Inner products of changes in detrended data:				
1970	−0.0251			
1975	−0.0423	−0.0351		
1980	0.0074	−0.0201	−0.0070	
1985	−0.0028	−0.0037	−0.0402	0.0138

comparisons for this period are negative, and the positive one is quite small and might be difficult to distinguish from sampling error. In contrast, all comparisons involving the interval centered in 1985 are positive and thereby reject a stable factor demand structure. Our findings are quite similar when we limit the analysis to men.

Figure III illustrates these patterns by plotting changes in log relative supplies against changes in log relative wages for the 64 labor groups for the period as a whole and for the three subperiods. The lines drawn in the figures represent predicted values from weighted least squares regressions of the changes in log wages on the changes in log factor supplies for each interval with the weights being the employment shares of each group in the initial period. The four graphs shown in the figure reinforce the findings from the inner products: for the 1963–1987 period as a whole and most strongly for the 1980s, the groups with the largest increases in relative supplies tended to have the largest increases in relative wages. Thus, when looking across groups, differential supply growth alone seems like an unlikely candidate to explain the observed changes in relative wages for the entire period. In fact, we find a negative relationship between growth in factor supplies and in relative wages only during the 1971–1979 period. These findings indicate that demand growth was an important component of the change in factor prices over the period as a whole and particularly during the 1980s. Delineating the time pattern and nature of these relative demand shifts is our next goal.

We first examine whether the observed wage changes can be made consistent with the observed pattern of relative quantity changes simply by allowing for smooth trend changes in relative demands. Such trend demand shifts might reflect a steady pace on nonneutral technological changes or steady changes in the industrial composition of employment. To do this, we regress the time series of relative wages and of quantities for each of our 64 groups on a constant and a linear time trend. We then average the residuals over five-year centered intervals for each group and compute the inner products in changes in detrended relative prices and relative quantities. The results of this procedure are shown in the bottom half of Table III. Comparing these numbers with those obtained without correcting for trend changes, we see that many more of the comparisons now show negative inner products. We infer from this that trend demand growth alone can make almost all of the observed price and quantity changes consistent with

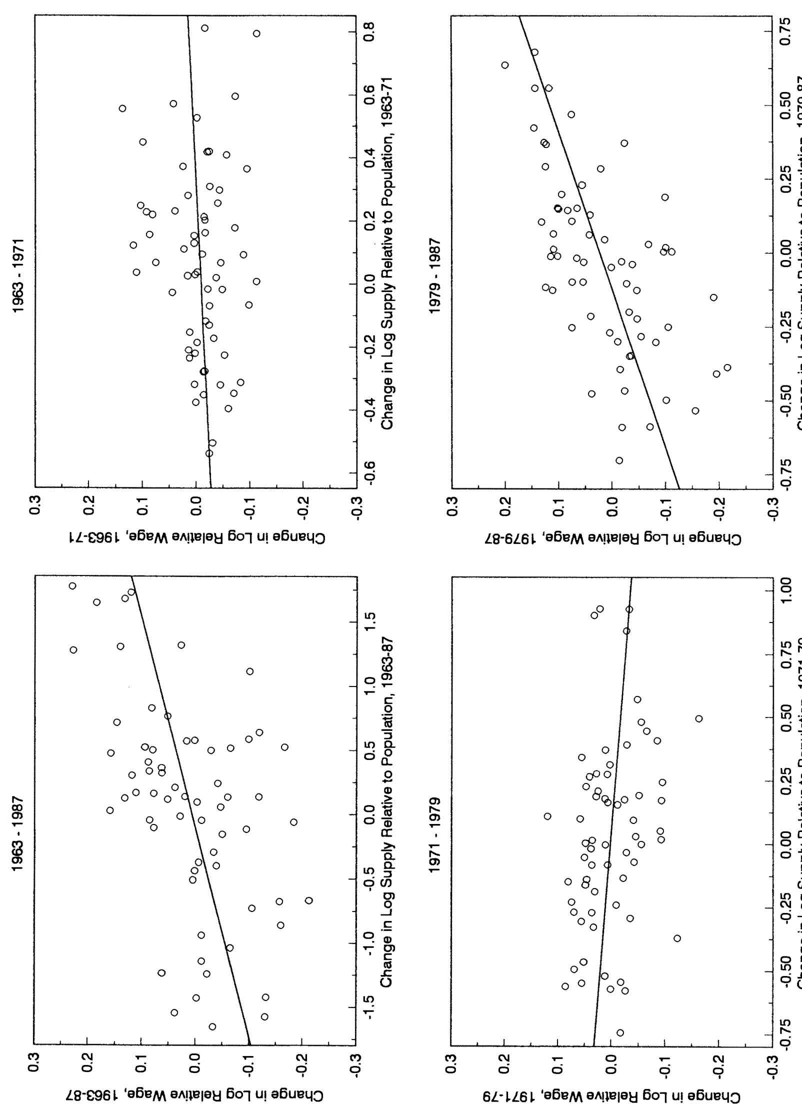

FIGURE III
Price and Quantity Changes for 64 Groups

otherwise stable demand, although the remaining positive inner product for the 1980s in detrended changes suggests some acceleration in the rate of growth of demand for women and more-educated workers in the 1980s appears necessary.

V. Measuring Changes in the Relative Demand for Labor

It is clear that substantial shifts in relative labor demand are necessary to explain observed changes in the wage structure since the early 1960s as reflecting changes in relative competitive wage levels. Changes in the structure of product demand, increased international competition, and skill-biased technological change have attracted much attention as possible reasons for shifts in labor demand against less-educated males. We find it useful to think of relative labor demand shifts as coming from two types of changes: those that occur within industries (i.e., shifts that change the relative factor intensities within industries at fixed relative wages) and those that occur between industries (i.e., shifts that change the allocation of total labor demand between industries at fixed relative wages). Important sources of within-industry shifts include factor nonneutral technological change, changes in prices of nonlabor inputs (e.g., computer services), and "outsourcing" (shifts of portions of industry production out of the United States). Between-industry shifts in demand may be driven by shifts in product demand across industries, sectoral differences in factor-neutral total factor productivity growth, and shifts in net international trade which change the domestic share of output at fixed relative wages.

The effect of between-industry shifts in labor demand on the relative demands for different demographic groups depends on group differences in industrial employment distributions. Table IV presents the distributions of employment among twelve broad industries and three major occupational categories of six gender-education groups.[10] The distributions in the table are the average distributions for each group over the 1967 to 1987 period.[11] The substantial differences in employment distributions indicate that

10. We focus on gender-education groups because differences in industrial distributions by sex and education are much more significant than differences by experience level.

11. Because of incompatibilities between the industry and occupation codes available in the 1964–1967 CPS surveys and those in the later surveys, we limit our analysis of shifts in labor demand arising from shifts across industry and occupation cells to the 1967–1987 period.

TABLE IV
AVERAGE INDUSTRIAL AND OCCUPATIONAL DISTRIBUTIONS OF SIX DEMOGRAPHIC GROUPS, 1967–1987[a]

	Percentage employment shares					
Years of schooling:	8–11	8–11	12	12	16+	16+
Gender:	Men	Women	Men	Women	Men	Women
Industry						
Agriculture and mining	9.8	3.0	6.4	1.8	3.0	1.0
Construction	14.1	0.7	11.2	1.4	3.4	0.6
Manufacturing:[b]						
Low tech	12.2	18.3	7.2	6.7	2.8	1.2
Basic	19.0	13.9	19.6	11.0	11.4	4.1
High tech	2.8	2.6	4.2	2.7	5.4	1.4
Communications, trans., and utilities	9.5	1.8	10.8	5.3	4.7	2.7
Wholesale trade	4.2	1.8	5.4	3.1	5.4	2.0
Retail trade	12.6	21.7	14.2	19.5	7.3	7.2
Professional, medical, and bus. services and FIRE	4.8	15.5	7.2	28.0	28.0	26.8
Education and welfare	2.2	5.9	1.9	7.6	19.0	45.5
Public administration	3.0	1.8	6.7	5.7	7.4	5.1
Other services	5.8	12.9	5.2	7.2	2.3	2.5
Occupation						
Professional, technical, and managers	9.3	6.8	19.7	15.2	77.3	76.9
Sales and clerical	5.6	19.8	12.3	52.2	12.6	17.5
Production and service workers	85.1	73.4	68.0	32.6	10.1	5.6

a. The numbers in the table for each demographic group represent the average share of employment (measured in total annual hours) of that group in the corresponding industry or occupation with the average taken over the 1967–1987 period.

b. Low tech manufacturing includes the lumber, furniture, stone, clay, glass, food, textiles, apparel, and leather industries. Basic manufacturing includes the primary metals, fabricated metals, machinery, electrical equipment, automobile, other transport equipment (excluding aircraft), tobacco, paper, printing, rubber, and miscellaneous manufacturing industries. High tech manufacturing includes the aircraft, instruments, chemicals, and petroleum industries.

shifts in labor demand across industries and occupations may greatly affect the relative wages of these groups.

Table V illustrates that large changes occurred in the industrial and occupational distribution of total employment over the 1967–1987 period. The shift over the entire period in the industrial employment distribution out of "low tech" and "basic" manufacturing and into professional and business services is suggestive of a trend demand shift in favor of college graduates and of women and against less-educated males. The substantial decline in importance of production worker jobs points toward similar demand shifts.

If within-industry relative factor demand is stable so that changes in the wage structure are entirely explained by between-

TABLE V
OVERALL INDUSTRY AND OCCUPATION EMPLOYMENT DISTRIBUTIONS, 1967–1987[a]

	Percentage employment shares				Full period change
	1967–1969	1973–1975	1979–1981	1979–1981	
Industry					
Agriculture and Mining	5.4	4.5	4.4	3.8	−1.6
Construction	6.2	6.8	6.6	6.7	0.5
Manufacturing:[b]					
Low tech	8.7	7.5	6.4	5.5	−2.8
Basic	17.1	15.0	14.4	12.0	−5.1
High tech	4.3	3.6	3.5	3.4	−0.9
Commun., trans., and utilities	7.3	7.2	7.3	7.1	−0.2
Wholesale trade	3.7	4.4	4.6	4.6	−0.9
Retail trade	13.7	13.9	13.6	14.3	−0.6
Prof., med., and bus. serv. and FIRE	13.4	16.7	18.9	21.5	8.1
Education and welfare	7.9	9.3	9.2	9.4	1.5
Public admin.	6.2	5.9	5.9	6.0	−0.2
Other services	6.0	5.1	5.3	5.9	−0.1
Occupation					
Prof/tech. and managers	28.1	29.6	32.0	35.4	7.3
Sales and clerical	21.3	21.8	22.5	22.4	1.1
Production and service workers	50.6	48.6	45.5	42.2	−8.4

a. The numbers in the table are percentage shares of total employment measured in total annual hours.
b. Low tech manufacturing includes the lumber, furniture, stone, clay, glass, food, textiles, apparel, and leather industries. Basic manufacturing includes the primary metals, fabricated metals, machinery, electrical equipment, automobile, other transport equipment (excluding aircraft), tobacco, paper, printing, rubber, and miscellaneous manufacturing industries. High tech manufacturing includes the aircraft, instruments, chemicals, and petroleum industries.

industry shifts in labor demand and relative supply changes, then the shares of industrial employment of groups whose relative wages have increased should tend to fall inside every industry. Thus, the hypothesis of stable within-industry demand implies that the shares of women and college graduates should have declined in all industries. Since the share of aggregate employment of women and college graduates increased over this period, this scenario requires a substantial shift in employment into industries that intensively employ women and more-educated workers. In fact, an examination of our CPS data indicates that the shares of employment (measured either in total hours or efficiency units) accounted for by women and by college graduates increased in almost every two-digit industry both from 1963 to 1987 and during the 1980s.[12] This finding indicates that within-industry demand shifts favoring these groups must have occurred. On the other hand, the finding that within-industry shifts must have occurred does not rule out the possibility that the between-industry shifts suggested by Table V are an important factor in explaining relative wage changes. We next more formally develop and implement a procedure for assessing the magnitude of between- and within-industry shifts in relative labor demands.

A. Conceptual Framework

One widely used measure of the effect of between-sector demand shifts on relative labor demands is the fixed-coefficient "manpower requirements" index (e.g., Freeman [1975, 1980]). This index measures the percentage change in the demand for a demographic group as the weighted average of percentage employment growth by industry where the weights are the industrial employment distribution for the demographic group in a base period.[13] In this section we clarify the interpretation of these demand shift measures. These simple demand shift indices provide appropriate demand shift measures for implementing equation (3) to determine whether within-sector relative demand shifts are necessary to explain observed shifts in relative wages. Although they provide biased measures of "true" between-sector relative demand shifts if relative wages are not stable, the nature of the bias can be determined. These demand shift indices tend to understate the relative demand shift favoring groups with increases in relative prices.

We begin our formal analysis by considering an economy that consists of J sectors (which can be thought of as industries or as industry-occupation cells) and K labor inputs. We denote output in sector J by Y_j and assume that production takes place under constant returns to scale in all sectors. We can write the $(K \times 1)$ vector of factor demands in sector j, X_j, as

$$X_j = C^j_w(W)Y_j, \tag{6}$$

12. Davis and Haltiwanger [1991] and Gottschalk and Joyce [1991] similarly report for the 1980s that the within-industry employment shares of groups increased with increases in relative wages.

13. This proxy for the percentage change in demand for demographic group k can be written as $\Sigma_j \lambda_{jk}(\Delta E_j/E_j)$, where j indexes industry, E_j is total employment of all demographic groups in industry j, $\lambda_{jk} = E_{jk}/(\Sigma_j E_{jk})$ in a base year, and E_{jk} is the employment of group k in industry j.

where $C^j_w(W)$ is the $(K \times 1)$ vector of unit factor demand curves (i.e., the partial derivatives of the unit cost function in sector j with respect to each group's own wage). Equation (6) can be written in terms of differentials as

$$dX_j = C^j_w(W)dY_j + Y_jC^j_{ww}(W)dW, \tag{7}$$

under the assumption that within-sector demand is stable. Premultiplying by W and using the result that unit factor demands are homogeneous of degree zero in factor prices, we derive

$$W'dX_j = W'X_j(dY_j/Y_j) \tag{8a}$$

or

$$\frac{dY_j}{Y_j} = \frac{W'dX_j}{W'X_j} \tag{8b}$$

so that we can measure the percentage change in outputs by the value weighted percentage change in inputs.

This result is particularly useful, since aggregating (7) across sectors yields

$$dX = \sum_j X_j \frac{dY_j}{Y_j} + C_{ww}dW = \sum_j X_j \frac{W'dX_j}{W'X_j} + C_{ww}dW, \tag{9}$$

where dX is the $(K \times 1)$ vector of employment changes and C_{ww} is the $(K \times K)$ matrix that corresponds to the production-weighted average of the Hessians (second partial derivatives) of the unit cost functions for the J industries and is negative semidefinite. Equation (9) implies that

$$dW'\left(dX - \sum_j X_j \frac{W'dX_j}{W'X_j}\right) = dW'C_{ww}dW \leq 0. \tag{10}$$

Equation (10) is of the form given in equation (3). Thus, an appropriate between-sector demand shift measure to evaluate whether the data are consistent with stable demand within-sectors is the $(K \times 1)$ vector;

$$\Delta D = \sum_j X_j \frac{W'dX_j}{W'X_j}, \tag{11}$$

which is simply the vector of weighted sums of sector employments for each factor with the weights given by the percentage changes in the value of inputs in each sector. This demand shift index is exactly the standard fixed-coefficients index with sectoral employment changes measured in efficiency units rather than in raw hours. The intuitive interpretation of the index is that those inputs employed heavily in expanding sectors will have increased demand, while those inputs employed mostly in contracting sectors will have falling demand.

It is important to note at this point that all quantities in equation (11) are the equilibrium changes in factor employments and are thereby directly measurable. No presumption has been made as to the source of the changes in employments other than the fact that the sector-specific unit cost functions are being held fixed.[14] Although the demand index given in equation (11) can be directly inserted into equation (10) to test for the stability of demand within sectors, this demand index does not provide an unbiased measure of "true" between-industry demand shifts when relative wages are changing.

The reason for this bias is that changes in relative wages can affect the distribution of sectoral outputs so that ΔD will not measure the effects of changes in the allocation of labor demand across sectors at fixed relative wages. The output shares of sectors that intensively employ groups with relative wage increases are likely to fall relative to what they would have been at stable relative wages. Thus, ΔD is likely to be a downward biased measure of demand shifts in favor of groups with relative wage increases.

More formally, we can write the $(J \times 1)$ vector of changes in relative outputs, dY_j, as

$$dY = dY^* + Y_p dP = dY^* + Y_p C_w dW, \tag{12}$$

where dY^* is the $(J \times 1)$ vector of "true" product demand shifts computed at fixed factor prices, P is the $(J \times 1)$ vector of sector output prices, Y_p is the $(J \times J)$ matrix of derivatives with respect to the price vector of the sectoral demand functions, and C_w is the $(J \times K)$ matrix of derivatives of the unit cost function with respect to own wages. The second equality arises from the assumption of constant returns to scale which implies that $dP = C_w(W)\,dW$. Using equations (6), (8a), (11), and (12), we can write our demand index as

$$\Delta D = \sum_j C_w^j(W) dY_j = (C_w)' dY = (C_w)' dY^* + (C_w)' Y_p C_w dW. \tag{13}$$

Equation (13) gives our demand shift measure in terms of the true

14. Katz and Murphy [1990] show that this demand measure is appropriate even in the presence of within-sector, factor-neutral technological change.

factor demand shift $(C_w)'dY^*$ and a bias term $(C_w)'Y_pC_wdW$. If $(C_w)'Y_pCw$ is negative semidefinite (as will be the case in the absence of income effects), this bias term will be inversely related to wage changes on average (i.e., the inner product of dW and the bias term will be nonpositive). In the two-factor case the between-sector demand index given in equation (11) will understate the demand increase for those groups with rising relative wages. More generally, our demand shift index will tend to understate the magnitude of the true relative demand shifts favoring groups with increases in relative wages.

B. Measured Demand Shifts, 1967–1987

To implement this approach to measuring demand shifts, we divide the economy into 50 two-digit industries and 3 occupation categories and take the resulting 150 industry-occupation cells as our sectors. The advantage of adding occupations to the industry taxonomies used in most previous work is that doing so allows us to look at some dimensions of within-industry shifts in labor demand, as well as between-industry shifts. In this framework we can think of occupations as producing intermediate goods within industries.

Empirically we construct our demand shift measure to correspond to the index ΔD defined in equation (11). We specify our index of the between-sector change in demand for group k measured relative to base year employment of group k in efficiency units, E_k, as

$$\Delta X_k^d = \frac{\Delta D_k}{E_k} = \sum_j \left(\frac{E_{jk}}{E_k}\right)\left(\frac{\Delta E_j}{E_j}\right) = \frac{\Sigma_j \alpha_{jk} \Delta E_j}{E_k} \tag{14}$$

where j indexes sector, E_j is total labor input in sector j measured in efficiency units, and $\alpha_{jk} = (E_{jk}/E_j)$ is group k's share of total employment in efficiency units in sector j in the base year. This measure expresses the percentage change in demand for each group as a weighted average of the percentage changes in sectoral employments (measured in efficiency units) in which the weights are group-specific employment distributions. We turn equation (14) into an index of relative demand shifts by normalizing all employment measures so that total employment in efficiency units in each year sums to one. We choose the average of the 1967–1987 sample period to be our base period.[15] Thus, we use the average

15. Our basic qualitative findings concerning measured demand shifts are insensitive to choice of base year.

share of total employment in sector j of group k over the 1967–1987 period as our measure of α_{jk} and the average share of group k in total employment over the 1967–1987 period as our measure of E_k.

We define our overall (industry-occupation) demand shift index for group k, ΔX_k^d, as the index given in (14) when j indexes our 150 industry-occupation cells. We also decompose this index into between- and within-industry components. The between-industry demand shift index for group k, ΔX_k^b, is given by the index in (14) when j refers to 50 industries. We define our within-industry demand shift index for k, ΔX_k^w, as the difference between the overall demand shift index and the between-industry demand shift index (i.e., $\Delta X_k^w - \Delta X_k^d - \Delta X_k^b$). These within-industry demand shifts reflect shifts in employment among occupations within industries.

Table VI presents our relative demand shift estimates for eight demographic groups for the entire 1967–1987 period and for three subperiods. The overall measure of demand shifts for the entire period is monotonically increasing in education level for both men and women. The overall measure also shifted in favor of women relative to men within every education group from 1967 to 1987. Since education differentials expanded and gender differentials narrowed over the 1967–1987 period, the actual between-sector demand shifts toward more-educated workers and women that would have occurred at fixed-factor prices are likely to have been even greater than the increases indicated in Table VI. The overall measure indicates that between-sector shifts in employment increased the demand for male college graduates by over 30 percent relative to males with twelve or fewer years of schooling. Demand shifts in favor of women are much greater for high school graduates and those with some college than for high school dropouts and college graduates. These differences reflect the concentration of males but not females with 12 to 15 years of schooling in production occupations and manufacturing industries.

Although the measured demand shifts toward more-educated workers and toward women have been substantial, they are significantly smaller than the observed relative supply changes documented in Table II. Thus, changes in relative wages and changes in relative supplies net of changes in the between-sector demand shift index positively covary over the 1967–1987 and the 1979–1987 period. Demand shifts within our industry-occupation cells are required to explain the observed extent of positive covariation in changes in relative wages and relative supplies.

TABLE VI
INDUSTRY AND OCCUPATION BASED DEMAND SHIFT MEASURES, 1967–1987[a]

Group	Change in log relative demand (multiplied by 100)											
	Between industry				Within industry				Overall (industry and occupation)			
	67–71	71–79	79–87	67–87	67–71	71–79	79–87	67–87	67–71	71–79	79–87	67–87
Males												
Dropouts (8–11 years)	−3.3	−4.8	−6.0	−14.1	0.7	−2.4	−2.9	−4.7	−2.6	−7.2	−8.9	−18.7
HS graduates (12 years)	−2.5	−3.0	−3.6	−9.0	0.3	−1.6	−1.7	−3.1	−2.2	−4.6	−5.3	−12.1
Some college (13–15 years)	−1.0	−0.6	0.4	−1.2	−0.2	0.5	0.9	−1.2	−1.2	−0.1	1.2	−0.0
College graduates (16+ years)	3.5	4.3	2.9	10.7	−1.1	2.6	4.3	5.8	2.4	6.9	7.2	16.5
Females												
Dropouts (8–11 years)	−5.0	−6.4	0.3	−11.1	0.4	−2.9	−3.3	−5.7	−4.5	−9.3	−3.0	−16.8
HS graduates (12 years)	0.4	1.1	4.3	5.8	1.1	0.2	−3.1	−1.8	1.5	1.3	1.2	4.0
Some college (13–15 years)	3.7	5.6	5.9	15.2	0.8	2.5	−0.9	2.4	4.5	8.1	5.0	17.6
College graduates (16+ years)	8.3	6.4	3.0	17.7	−0.4	1.8	1.8	3.1	7.8	8.2	4.7	20.8

a. The overall and between-industry demand shift measures for group k are of the form $\Delta D_k = \Sigma_j \alpha_{jk}(\Delta E_j/E_k)$ where α_{jk} is the average share for group k of employment in sector j over the 1967–1987 period, E_j is the share of aggregate employment in sector j, and E_k is the average share of total employment of group k for 1967–1987. The reported numbers are of the form $\log(1 + \Delta D_k)$. In the overall measure, j indexes 150 industry-occupation cells. In the between-industry measure, j indexes 50 industries. The within-industry index for group k in year t is the difference of the overall and between-industry measures for group k in year t. In all calculations, employment is measured in efficiency units.

Table VI also suggests that the pace of overall demand growth for college graduates appears to have been relatively steady over the 1967–1987 period. On the other hand, there are some differences in the time pattern of shifts in the demand for female and male college graduates. The magnitude of relative demand shifts favoring college males appears to have increased in the 1980s, while demand shifts favoring female college graduates are smaller in the 1980s than in the earlier periods. These differences reflect the rapid growth of the professional and business services in the 1980s and the decline in relative employment in education and the public sector in this same period. Furthermore, the overall demand shift index masks important differences in the between- and within-industry measures of demand shifts. Between-industry shifts for college graduates appear to have decelerated in the 1980s, while within-industry demand shifts (largely reflecting an accelerating rate of decline in the share of production jobs within industries) have accelerated throughout the period.

C. Demand Shifts Arising from Changes in International Trade

We next examine the importance of changes in net international trade in manufactured goods as a source of relative labor demand shifts.[16] Many have argued that increased import competition particularly with the large U. S. trade deficits of the 1980s has played an important role in shifting employment out of manufacturing sectors and shifting relative demand against less-educated workers.

To estimate the labor supply equivalents of trade, we transform trade flows into equivalent bodies on the basis of the utilization of labor inputs in the domestic manufacturing industries that constitute the bulk of the traded goods sector. We do this by estimating the direct labor supply embodied in trade, ignoring indirect input-output effects. Thus, the implicit labor supply in trade is the labor input required to produce traded output domestically. Formally, we let I_{it} be net imports in industry i in year t, Y_{it} be domestic output of industry i in year t, and E_{it} be the share of total efficiency units in the U. S. economy in year t employed in sector i ($\Sigma_i E_{it} = 1$). The implicit supply of labor embodied in net imports in industry i in year t measured as a fraction of total U. S. labor input

16. See Borjas, Freeman, and Katz [1992] and Murphy and Welch [1991] for more detailed treatments of the effects of international trade flows on relative labor demands.

is given by $(E_{it}/Y_{it})^*I_{it}$. The implicit supply of labor of demographic group k contained in net trade in year t as a fraction of total domestic labor supply of k is given by

$$L_t^k = \sum_i e_i^k E_{it} \left(\frac{I_{it}}{Y_{it}}\right), \tag{15}$$

where e_i^k is the average proportion of employment (measured in efficiency units) in industry i made up of workers in group k over the 1967–1987 period.

We measure the effect of trade on relative demand for demographic group k in year t as

$$T_t^k = -\left(\frac{1}{E^k}\right) \sum_i \left[e_i^k E_{it} \left(\frac{I_{it}}{Y_{it}}\right)\right] + \sum_i E_{it} \left(\frac{I_{it}}{Y_{it}}\right), \tag{16}$$

where E^k is the average share of total employment in efficiency units of group k for the 1967–1987 period. The first term is simply the implicit supply of the labor of group k contained in trade normalized by base year employment of k with the sign reversed to convert this supply shift measure into a demand shift measure. The second term adjusts the demand shift measure so that trade affects only relative demands for labor.[17]

In equation (16) we assume that trade-induced changes in an industry's output alter the employment of production and nonproduction workers in that industry in the same manner as would domestic-induced changes in output. Alternatively, however, it is plausible that exports and imports may affect quite different portions of an industry and may have differential impacts on the employment of production and nonproduction workers. In particular, while exports and production for domestic consumption may create employment for both kinds of workers in a similar manner, imports may displace production workers to a far greater extent than they displace nonproduction workers. In fact, many activities of nonproduction workers (e.g., marketing, sales, accounting) may be relatively complementary with production workers overseas. To take into account this issue, we provide two estimates of the effects of trade on employment. Under the first method which we denote "equal allocation," we directly employ equation (16) and treat net imports in a manner analogous to domestic production for domes-

17. This demand shift index has the property that $\Sigma_k T_i^k E^k = 0$. Murphy and Welch [1991] provide a formal justification for this type of demand shift index.

tic consumption. Under the second method which we denote "production worker allocation," we modify the first term in equation (16) so that exports are allocated to all workers in the same manner as domestic production for domestic consumption, but imports are allocated to production workers only.[18]

We use data on imports, exports, and output from the NBER Immigration, Trade, and Labor Market Data Files to compute the trade ratios used in the construction of our indices of demand shifts arising from trade.[19] These data cover four-digit SIC manufacturing industries for each year from 1967 to 1985. We aggregate these data into 21 two-digit manufacturing industries.

Table VII presents the changes in relative labor demand predicted by changes in international trade in manufactures for the 1967–1973, 1973–1979, and 1979–1985 periods. The table indicates that the effects on relative labor demands of trade were quite moderate until substantial trade deficits developed in the 1980s. The adverse effects of trade on relative labor demand are concentrated on high school dropouts. Female dropouts who have traditionally been employed intensively as production workers in import-competing industries such as apparel and textiles are the group most affected by trade. In fact, demand changes from trade are larger for female high school dropouts in the 1980s than are domestic sources of between-sector demand shifts. The table also indicates that the effects of trade on relative labor demand are substantially larger when imports are assumed to disproportionately affect production workers. Although trade-induced changes in relative demand move in the correct direction to help explain rising education differentials in the 1980s, they are quite small relative to the increases in the relative supplies of more-educated workers over the same period.

18. We replace the first term on the right-hand side of the equation (16) with

$$-\left(\frac{1}{E^k}\right)\sum_i \left\{\left[e_i^k E_{it}\left(\frac{X_{it}}{Y_{it}}\right)\right] - \left[p_i^k E_{it}\left(\frac{M_{it}}{Y_{it}}\right)\right]\right\},$$

where X measures exports, M measures imports, and p_i^k is group k's average share of production worker employment in industry i over the 1967–1987 period. We classify as production workers those workers in the manufacturing sector in the following broad occupational categories: craft workers, handlers and laborers, operatives, transport operatives, and service workers.

19. Abowd [1991] provides a detailed discussion of this data set and the construction of trade data on a four-digit SIC industry basis. The data on output and employment in each industry given by the NBER data set are from the Annual Survey of Manufactures.

TABLE VII
CHANGES IN RELATIVE LABOR DEMAND PREDICTED BY CHANGES IN INTERNATIONAL TRADE IN MANUFACTURES, 1967–1985[a]

	Change in relative labor demand from trade by group measured as percent of group base-year employment[b]					
	Equal allocation[c]			Production worker allocation[d]		
Group	67–73	73–79	79–85	67–73	73–79	79–85
Males						
Dropouts (8–11 years)	−0.16	0.07	−0.63	−0.50	−0.25	−1.48
HS graduates (12 years)	−0.08	0.08	−0.28	−0.27	−0.10	−0.71
Some college (13–15 years)	0.04	0.05	0.07	0.16	0.21	0.42
College graduates (16+ years)	0.18	0.02	0.55	0.58	0.42	1.50
Females						
Dropouts (8–11 years)	−0.48	−0.25	−2.22	−0.76	−0.32	−4.00
HS graduates (12 years)	−0.08	−0.15	−0.16	−0.11	−0.21	−0.27
Some college (13–15 years)	0.12	−0.15	0.08	0.17	−0.23	0.11
College graduates (16+ years)	0.22	−0.20	1.26	0.24	−0.25	1.50

a. Data on trade flows are from the NBER Immigration, Trade, and Labor Market data files. Labor input data are from the March CPS files.
b. Base-year employment for each group is that group's average share of total employment from 1967–1985.
c. Imports and exports are assumed to affect production and nonproduction workers in the same manner as production for domestic consumption.
d. Imports are assumed to affect production workers only, and exports are assumed to affect all workers in the same manner as does production for domestic consumption.

VI. UNDERSTANDING CHANGES IN EDUCATION AND EXPERIENCE DIFFERENTIALS

A. Education Differentials

The college/high school wage premium increased from 1963 to 1971, fell from 1971 through 1979, and then rose sharply after 1979. There are two primary types of explanations for these movements in the college/high school wage differential. The first interprets these changes in relative earnings as representing changes in the relative market price of skills possessed by college and high school graduates.

The second type of explanation focuses on changes in the composition of college and high school graduates that affect the relative skill levels of the two groups. This type of explanation interprets the decline in the college wage premium in the 1970s as reflecting a decline in the relative quality of college graduates and the rise in education returns in the 1980s as reflecting a decline in the relative quality of high school graduates. Because within-cohort comparisons are likely to hold the relative quality of college and high school graduates relatively constant, this hypothesis suggests one should not find important within-cohort changes in the college wage premium. Since movements in the college/high school wage differential are quite similar within cohorts and within experience levels over our sample period [Blackburn, Bloom, and Freeman, 1990; Katz and Murphy, 1990], we conclude it is appropriate to view differences in the movement in the college wage premium in the 1960s, 1970s, and 1980s as largely reflecting changes in the relative price of college skills rather than as primarily reflecting changes in the relative quality of college graduates. Thus, we turn to evaluating supply and demand explanations for changes in the relative price of college skills.

We take the overall college/high school wage ratio for males and females combined as the relative price to be explained.[20] We amalgamate our 320 groups into two labor aggregates: college equivalent workers and high school equivalent workers. We use the relative quantity of college and high school equivalents as our relative supply variable in assessing explanations for movements in the college/high school wage ratio.

We create our measures of college and high school equivalents as follows. We construct aggregate labor inputs (using a fixed-weight total supply measure with weights proportional to average wages over the 1963–1987 period) for each of our four education groups (8–11, 12, 13–15, and 16+ years of schooling). We treat high school graduates (those with twelve years of schooling) as pure high school equivalents, and we treat college graduates as pure college equivalents. We allocate other categories of workers (those with less than twelve years of schooling and those with some college) to our two aggregate groups on the basis of regressions determining the extent to which their wages move with the wage of

20. In this section we measure the college/high school wage ratio as the fixed-weight average of the ratio of the average weekly wage of college graduates to the average weekly wage of high school graduates for sixteen cells defined by sex and five-year experience brackets. The fixed weight for each cell is the cell's average share of total employment over the 1963–1987 period. This series is plotted in Panel B of Figure I as the college/high school wage ratio for all experience levels.

high school graduates and college graduates, respectively. For those with less than a high school degree and those with some college, we regress the average wage series for each of these two groups on the wage series for high school graduates and for college graduates over the 1963–1987 period.[21] (The implicit assumption is that each group is a linear combination of college and high school graduates). The regression results suggest that one person with some college is equivalent to a total of 0.69 of a high school graduate and 0.29 of a college graduate, while a high school dropout is equivalent to 0.93 of a high school graduate and −0.05 of a college graduate. We use these coefficients to allocate the corresponding quantities of high school dropouts and those with some college to the high school and college quantities to form the supplies of high school and college equivalents.

We consider the simplest CES technology with two factors (college and high school equivalents) so that relative wages in year t, $w_1(t)/w_2(t)$, and relative supplies in year t, $x_1(t)/x_2(t)$, satisfy the relationship

$$\log\left(\frac{w_1(t)}{w_2(t)}\right) = \left(\frac{1}{\sigma}\right)\left[D(t) - \log\left(\frac{x_1(t)}{x_2(t)}\right)\right], \tag{17}$$

where σ is the elasticity of substitution between college and high school equivalents and $D(t)$ is the time series of relative demand shifts measured in log quantity units. Given that there are other inputs in the production function, this is a conditional factor demand framework which requires that demand shifts be defined to include the effects of changes in the prices (or equivalently the supplies) of these other inputs.

The elasticity of substitution is an unknown parameter, and the time series of $D(t)$ is unobservable. Under the assumption that the economy operates on the demand curve given by equation (17), a given value of the elasticity of substitution between factors ($\sigma = \sigma_0$) implies a time series of demand shifts:

$$D(t) = \sigma_0 \log\left(w_1(t)/w_2(t)\right) + \log\left(x_1(t)/x_2(t)\right). \tag{18}$$

The greater the elasticity of substitution between the two factors, the smaller the impact of shifts in relative supplies on relative wages and the greater must be the fluctuations in $D(t)$ to explain any given time series of relative prices for a given time series of observed relative quantities.

21. The regressions do not contain intercept terms.

We take two approaches to developing stories consistent with the observed time series on prices and quantities. The first is to estimate σ by running (17) by ordinary least squares under the assumption that $D(t)$ is approximated by a simple linear time trend. We are somewhat skeptical of estimates of σ recovered from 25 nonindependent time series observations. Our second approach is to use equation (18) to impute $D(t)$ conditional on a choice for the value of σ. For any given value of σ, we can evaluate the implied explanation by examining whether the implied time series for $D(t)$ matches well with the measures of between- and within-industry demand shifts developed in the previous section.

The basic movements in our relative price and relative quantity measures over our sample period are summarized in the top part of Table VIII. The relative supply of college equivalents grew tremendously over this period, and the college wage premium increased substantially. A regression of the log of the ratio of the supply of college to high school equivalents on a linear time trend for the 1963–1987 period yields a coefficient of 0.045 ($t = 41.5$), and the log relative price series is almost orthogonal to trend. Hence the relative demand for college equivalents has grown by about 4.5 percent per year on average over the sample period.

The key question to be addressed is the degree to which the time series of the college wage premium has been driven by fluctuations in the growth of supply versus the extent to which it has been driven by fluctuations in demand-side factors. Figure IV graphs the detrended wage and price series (in Panels A and B). Since the price series has little trend, the series in Panel A is quite similar to the overall returns to college series. The quantity series plotted in Panel B and summarized in Table VIII reveals some important features, however: supply grew more slowly than average from 1963–1971, faster than average from 1971 until about 1979, and then more slowly than average again in the 1980s. It appears that an explanation emphasizing fluctuations in supply growth has the potential to explain observed fluctuations in the college wage premium.

Thus, the model in equation (17) in which $D(t)$ is proxied by a linear time trend may fit the data reasonably well. OLS estimation of this equation for the 1963–1987 period yields

$$\log(w_1/w_2) = \underset{(0.150)}{-0.709}\log(x_1/x_2) + \underset{(0.007)}{0.033}\,\text{time} + \text{constant}, \tag{19}$$

with an R^2 of 0.52. The estimate of σ in (19) implies an elasticity of

TABLE VIII
COLLEGE/HIGH SCHOOL RELATIVE WAGES, QUANTITIES, AND DEMAND SHIFTS

Variable	Log Change (multiplied by 100)					
	1963–1971	1967–1971	1971–1979	1979–1987	1963–1987	1967–1987
College/high school weekly wage ratio[a]	7.7	3.0	−10.4	12.8	10.0	5.4
Relative supply of college to high school equivalents	31.4	16.6	40.8	25.5	97.6	82.9
Measured relative demand shifts—college/high school[b]						
Overall (industry-occupation)	—	4.6	10.2	9.9	—	24.8
Between industry	—	5.9	6.7	4.6	—	17.2
Within industry	—	−1.3	3.6	5.2	—	7.6

a. The college/high school weekly wage ratio is the fixed-weight average of the ratio of the average weekly wage of full-time college graduates to full-time high school graduates for sixteen gender-experience groups. The fixed weights for each group are the average shares of that group in total employment for the 1963–1987 period.
b. These demand shift measures are the corresponding measures from Table VI aggregated to measure shifts in the demand for college equivalents relative to high school equivalents.

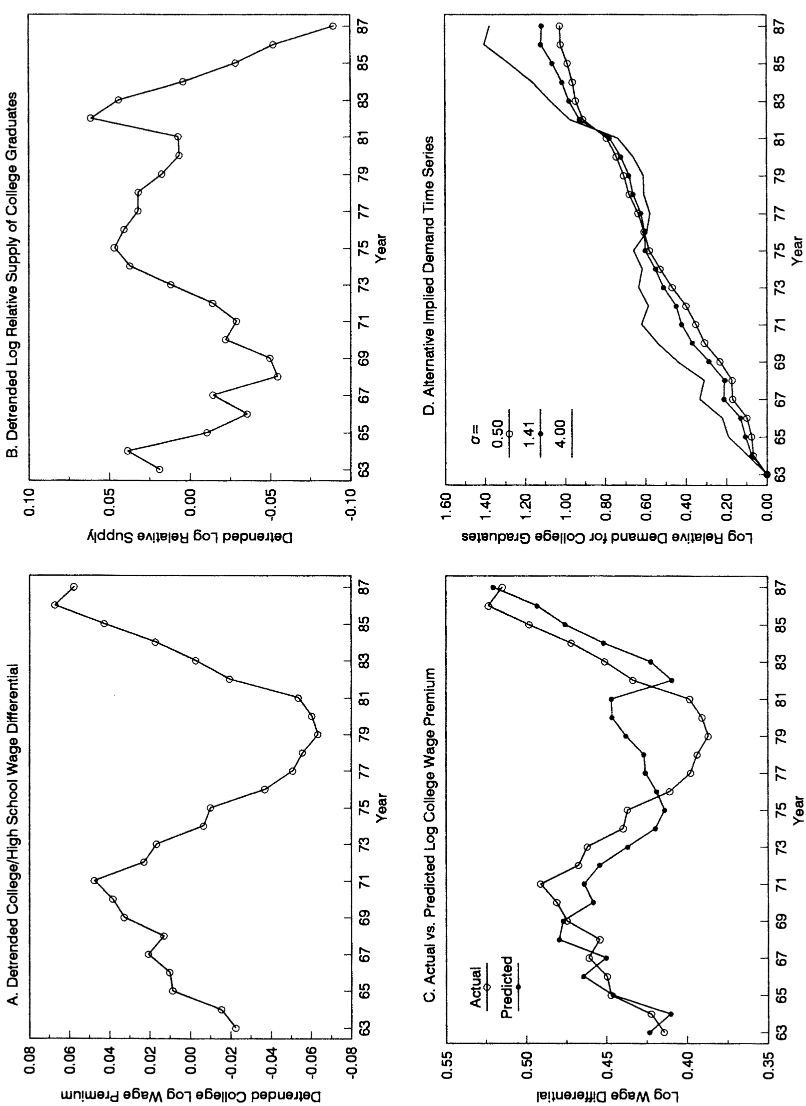

FIGURE IV
Education Differentials: Supply and Demand Analysis

substitution between college and high school labor of about 1.41. The actual time series of college returns and the fitted values from this regression are shown together in Panel C of Figure IV. The figure shows that this model does a tolerable job of explaining the movements in the college wage premium except for the period from the late 1970s to the early 1980s.

Panel D in Figure IV shows the implied demand series derived from (18) for elasticities of substitution of 0.5, 1.41, and 4 with demand normalized to equal 0 in 1963. The figure illustrates that there is a one-dimensional family of implied demand shifts (indexed by σ) that are consistent with the observed price and quantity time series. The implied demand shifts range from relatively steady demand growth when σ is small (0.5 to 1) to demand growth which slows significantly in the 1970s and accelerates greatly during the 1980s when σ is moderate to high.

To see how alternative demand shift scenarios compare with the observed pattern of between-sector demand shifts calculated in the previous sections, we aggregate the demand shift measures by education-gender groups presented in Table VI into demand shifts for college equivalents relative to high school equivalents. Table VIII compares these shifts with movements in the relative supply of college equivalents. Our demand shift index implies that the relative demand for college graduates increased by 10.2 percent from 1971–1979 and by 9.9 percent from 1979–1987. There is little direct indication of an acceleration in the growth of the relative demand for more highly educated workers from these demand shift indices. On the other hand, our analysis of the nature of the bias in these indices indicates that the demand shift index understates the "true" between-sector growth for college graduates relative to high school graduates in the 1980s and overstates the shifts in the 1970s. Furthermore, the overall demand shift measure masks a combination of a deceleration in measured between-industry demand shifts and an acceleration in measured within-industry demand shifts from the 1970s to the 1980s. The measured demand shifts explain about one third of the implied trend demand shifts consistent with the observed time series of prices and quantities.

B. Experience Differentials

We next examine explanations for movements in experience differentials for males over the 1963–1987 period. We focus on males, since our measure of potential experience is likely to be a worse indicator of actual experience for women than for men. We take the ratio of the wage of males with 26 to 35 years of experience (old workers or peak earners) to the wage of males with 1 to 5 years of experience (young workers or new entrants) as the relative price to be explained.

The path of the log old/young wage differential for all males over our sample period is presented in Panel A of Figure V. The overall old/young wage differential for males was reasonably constant from the mid-1960s to 1970, increased sharply in the early 1970s, remained stable in the late 1970s, and increased greatly in the 1980s. The log old/young wage differential increased by approximately 0.12 over the entire period. The time pattern of the changes in experience differentials for all men is dominated by changes for those with less than sixteen years of schooling. Panel D of Figure I showed that experience differentials increased markedly from 1979 to 1987 for high school graduates and actually fell for college graduates over the same period. These sharp differences in a period of rising education differentials are suggestive of the "active labor market" hypothesis of Freeman [1975] in which changes in the labor market show up most sharply for new entrants because more senior workers are insulated by labor market institutions, such as seniority layoff systems, and valuable firm-specific capital. In particular, the collapse of new employment opportunities for less-educated workers in the manufacturing sector in the 1980s is likely to have had its most severe impact on young less-educated males.

We first examine the ability of changes in the relative supply of more- to less-experienced workers to explain changes in experience differentials. Table II indicates that the relative supply of workers with one to ten years of experience increased greatly over the entire 1963–1987 period but actually declined in the 1980s as the baby boom cohort workers became more experienced and the baby bust cohort entered the labor market. This suggests that the growth in relative supply of young workers can help explain the secular growth in experience differentials but will have trouble explaining changes in the 1980s. On the other hand, the fraction of workers with eleven to twenty years of experience grew rapidly in the 1980s, and it is a priori unclear how an expansion of the supply of workers in this group affects the earnings of new entrants relative to peak earners.

We attempt to deal with the issue of how multidimensional changes in the age structure of the labor force affect the relative earnings of old to young workers by using a relative supply variable

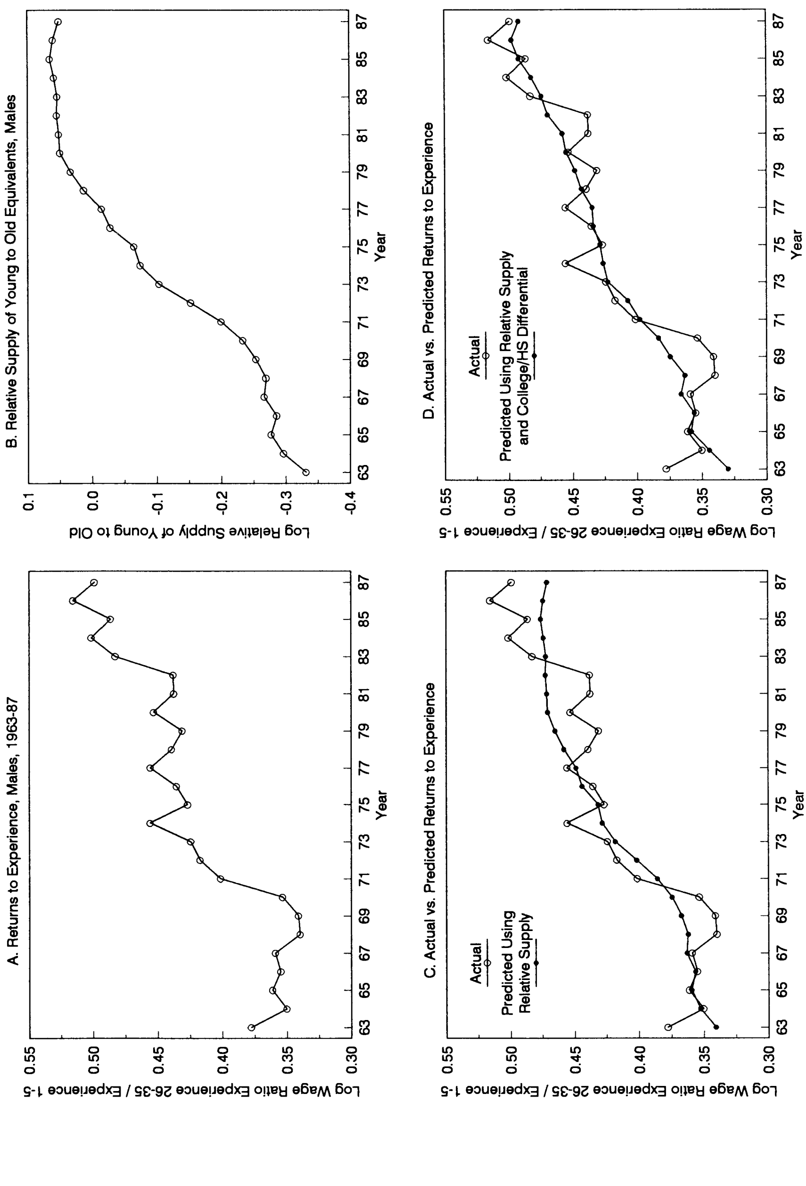

FIGURE V
Experience Differentials for All Males: Supply Factors

that aggregates all experience groups into two groups (old and young equivalents). The construction of this variable is exactly analogous to the construction of college and high school equivalents above. We treat workers with 26 to 35 years of experience as pure old equivalents and those with 1 to 5 years of experience as pure young equivalents. We allocate workers in the five other five-year experience brackets (6–10, 11–15, 16–20, 21–25, 36–40 years) to our two aggregate groups on the basis of regressions (without intercepts) of their wages on the wages of those with 26–35 and 1–5 years of experience.[22]

We display the time path of the log relative supply of young to old equivalents in panel B of Figure V. The basic movements in the relative supply of young to old equivalents look quite similar to a smoothed version of the changes in the old/young wage ratio illustrated in panel A of the figure. In particular, the long-term growth in experience differentials is quite consistent with the long-term increase in the share of young equivalent workers. Yet the timing of the changes in experience differentials (particularly movements in the mid-1970s and the 1980s) does not match up well with the smoothly declining rate of growth of the relative supply of young equivalents.

These points are brought out by a comparison of movements in actual experience differentials and the predicted values from a regression over the 1963–1987 of the log old/young wage ratio on the log relative supply of old to young equivalents.[23] The actual and predicted values from this regression are contrasted in panel C of Figure V. The regression does a good job of explaining the secular growth in experience differentials but fails to explain the sharp increase in the 1980s. The active labor market hypothesis suggests that a weak market for less-educated workers may help explain widening experience differentials for less-educated workers since young less-educated workers will bear the brunt of adjustment to changing market conditions. The addition of the log of the overall college/high school wage ratio to our specification (essentially as a

22. On the basis of these regressions, we define the number of old (N_0) and of young equivalents (N_y) as

$$N_y = n_1 + 0.92n_2 + 0.86n_3 + 0.53n_4 + 0.38n_5 + 0.07n_6 - 0.07n_7 - 0.01n_8$$

$$N_0 = 0.23n_2 + 0.39n_3 + 0.66n_4 + 0.77n_5 + 0.97n_6 + 1.037n_7 + 0.98n_8,$$

where n_j is the fixed-weight total supply of workers in the jth five-year experience group (i.e., n_1 is the supply of those with one to five years of experience, etc.).

23. This regression yielded a coefficient (standard error) of -0.342 (0.032) on the log relative supply variable and an R^2 of 0.83.

proxy for relative demand shifts in favor of older workers) improves the ability of the regression to explain movements in overall experience differentials as is illustrated in panel D of Figure V.[24] Relative supply movements combined with the state of the labor market for educated workers go a long way toward explaining changes in experience differentials for men.

VII. Conclusions

A simple supply and demand framework helps illuminate many aspects of changes in the U. S. wage structure. The relative wages and quantities of more-educated workers and women increased substantially from 1963 to 1987. Within-group and overall wage inequality also increased sharply over this period. Substantial secular growth in the demand for more-educated workers, females and "more-skilled" workers within groups is necessary to interpret the observed changes in relative wages as changes in competitive skill prices. Measured changes in the allocation of labor demand between sectors (150 industry-occupation cells) can account for a large minority of the secular demand shifts in favor of groups with rising relative wages. Demand shifts arising from changes in international change in manufacturing only start to be of quantitative significance with the appearance of large trade deficits in the 1980s. The majority of the required demand shifts in favor of more-educated workers and females reflect difficult to measure changes in within-sector relative labor demand. Recent work by Krueger [1991] suggests that the spread of computers in the workplace may be an important component of these within-sector changes in the composition of labor demand.

The pattern of changes in the wage structure differed substantially in the 1960s, 1970s, and 1980s. The college wage premium increased moderately in the 1960s, declined in the 1970s, and expanded dramatically in the 1980s. Differences across the three decades in the rate of the growth of the supply of college graduates as a fraction of the labor force appear to play an important role in explaining these large differences in the behavior of the relative earnings of college graduates. Fluctuations in the rate of growth of relative supply do not greatly help illuminate differences across

24. The regression of the log relative earnings of old to young males (RE) on the log relative supply of old to young equivalents (RSUP) and the log of the overall college/high school wage premium (CHSPREM) yields a coefficient (standard error) of -0.348 (0.028) on RSUP and of 0.292 (0.106) on CHSPREM and has an R^2 of 0.87.

decades in changes in the male/female wage differential. Within-group earnings inequality was stable in the 1960s and has increased steadily since the early 1970s. The differences in the time pattern of rising education differentials and rising within-group inequality suggest that they are at least partially distinct economic phenomena.

Much recent work indicates that economic pressures toward increased inequality and skill differentials arising from between-industry shifts in labor demand and skill-biased technological change appear important in most OECD economies in the 1980s (e.g., Gottschalk and Joyce [1991]; Katz and Loveman [1990]). Although wage structures appear to have started to expand in almost all OECD countries by the middle of the 1980s, the magnitude of the changes varies substantially. The extent to which this divergence in wage structure changes across countries is explained by differences in the supply and demand factors emphasized in this paper as opposed to differences in wage-setting institutions is an important topic for future research.

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