Factor Proportions and Relative Wages: The Supply-Side Determinants of Wage Inequality

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Wages and incomes are distributed more unequally in the United States than in any other OECD country. In 1990, households from the top decile of the U.S. income distribution had disposable incomes that were nearly six times greater than households in the bottom decile. The comparable ratio in Canada was 4.0, in the United Kingdom, 3.8, and in Sweden it was 2.7 (Freeman and Bjorklund, forthcoming). It wasn't always so, however. In the late 1960s, wage inequality among American men was not much different than among Swedes, who are known for their obsession with income equality. From 1970 to the present, the difference in wages between high- and low-wage American men steadily increased; for example, the gap between men in the top and bottom deciles of the wage distribution widened by more than 30 percentage points. In part, the gap has opened because the real wage of men in the bottom decile of the income distribution has fallen by more than 20 percentage points since 1970. For the period where reliable data are available, no other developed country has witnessed such a dramatic increase in inequality.

The trend toward rising inequality is not confined to the United States; with differences in degree and timing, wage dispersion has increased throughout the developed world (Davis, 1992; Blau and Kahn, 1996; Katz, Loveman and Blanchflower, 1995). In general, rising overall wage dispersion has been concomitant with increases in wage differentials based on observable proxies for skill, such as experience, education and occupation. This is strong evidence that increases in inequality are driven by a steady increase in the relative demand for skilled labor, which has outrun the increasing supply of such labor. In this framework, the "solution"

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to the economic and social problem of rising inequality is that changes in the supply of skills must, through investments in human capital, catch up with the rise in demand for skilled labor.

My purpose here is to evaluate the impact of changes in the supply of skills on wage differentials and inequality. This investigation has two aspects. First, certain changes in labor supply are alleged to exacerbate inequality. The two leading candidates are immigration and the increased labor force participation of women. Both of these factors may increase the supply of relatively low skilled labor and thus may drive down the wages of low-wage natives. However, the sign and size of these effects depend on substitution possibilities; for example, on whether women who have entered the labor force are good or poor substitutes for low-skilled men, whose wages have fallen. Most evidence suggests that the effects of immigration on wages have been minor. Evidence on the impact of women's labor force participation is not conclusive; the effect could be large, but the necessary patterns of substitution are doubtful.

A second reason to study the impact of labor supply on relative wages is to evaluate the likelihood that human capital investment will mitigate rising inequality. For instance, since 1980, a rising wage gap between college and high school graduates has encouraged college attendance, and, indeed, college attendance has risen. These new college graduates augment future stocks of highly skilled workers, so skilled labor will be less scarce. Will increased supply reduce the relative wages of college-educated workers? Again, the answer depends on how well different skill groups substitute for one another in aggregate production. When the demand for college-educated labor is fairly inelastic—implying that college and high school graduates are poor substitutes—increased supply of college graduates will reduce their relative wage. Evidence from the 1970s and 1980s implies that increased numbers of college graduates will limit the growth of wage inequality, but that the main effect will be among relatively high-wage workers. There is less reason to be optimistic that human capital investment will soon raise the wages of low-skilled workers.

The following discussion focuses on inequality of men's wages, leaving to the side a detailed analysis of changes in the distribution of women's relative wages. I do this because the phenomenon of rising wage inequality is most acute for men; indeed, women's relative wages and labor force participation have been rising over time. The evolution of women's wages raises separate issues that have been treated elsewhere, but I do not dwell on those issues here.

Empirical Background

I begin by establishing some facts about the evolution of wage inequality in the United States. Figure 1 shows the evolution of relative hourly wages among American men since 1963. The three curves in the figure represent the wages of men at the 90th, the 50th and the 10th percentiles of the wage distribution, all indexed to 1969. Thus, for example, the lowest curve in the figure represents the wages of workers at the 10th percentile, which fell by roughly 26 percent (30 log points)

Figure 1
**Log Wages Indexed to 1969: 90th, 50th and 10th Percentiles**
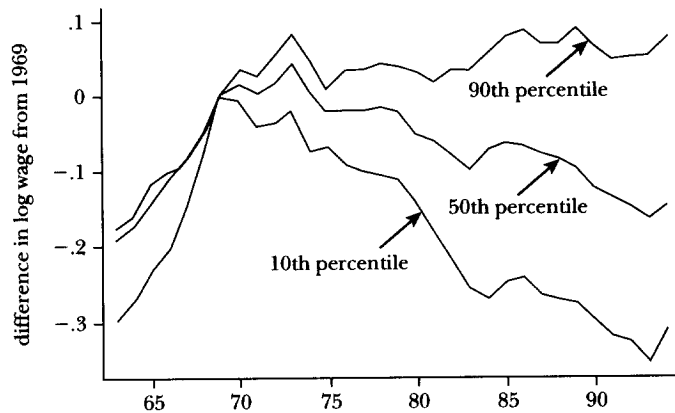
between 1969 and 1994. In contrast, the wages of men in the 90th percentile rose by about 10 percent (10 log points). As a measure of inequality, then, the "90–10" wage differential among American men expanded by a startling 49 percent (40 log points) in 26 years, with over two thirds of this gap attributable to a decline in real wages among those in the 10th percentile. In a nutshell, this is the problem of rising wage inequality in the United States.

Figure 1 also illustrates some variations over time in the magnitude and timing of changes in wage inequality. Wages at the 90th and 50th percentiles moved roughly in sync from 1963 to 1979, but grew apart thereafter. The 90–50 differential rose by only 5 percentage points from 1969 to 1979, but by 16 percentage points from 1980 to 1994. This "delay" in the rise of the 90–50 wage differential is part of the reason for Blau and Kahn's (1996) conclusion, using data from the late 1980s, that inequality in the upper half of the U.S. wage distribution is not much different than in other countries. In contrast, the widening of the 50–10 differential began in the early 1970s. It grew by 9 percentage points from 1969 to 1980, and by another 9 points from 1980 to 1986. However, since 1986, the 50–10 wage differential has been more-or-less unchanged. Overall, since 1969, the 90–50 and 50–10 wage differentials in the United States have grown by roughly equal proportional amounts.

Most economists interpret the changes shown in Figure 1 as reflecting increases in the relative price of workers' skills, with more skilled workers commanding a higher relative wage over time. Of course, "skill" has many dimensions, ranging from innate ability to human capital acquired in the work place and in formal schooling. Though none of these are directly observable, standard data sets such as the Current Population Survey record respondents' years of schooling, age and other demographic characteristics. Economists can then estimate the returns to education or experience by the percentage wage difference between workers with various amounts of schooling or time on the job. Figure 2 offers some evidence on the returns to education and to experience.

Figure 2

Wage Ratios for College vs. High School Graduate and High-Experience (25–35) vs. Low-Experience (0–10) Workers
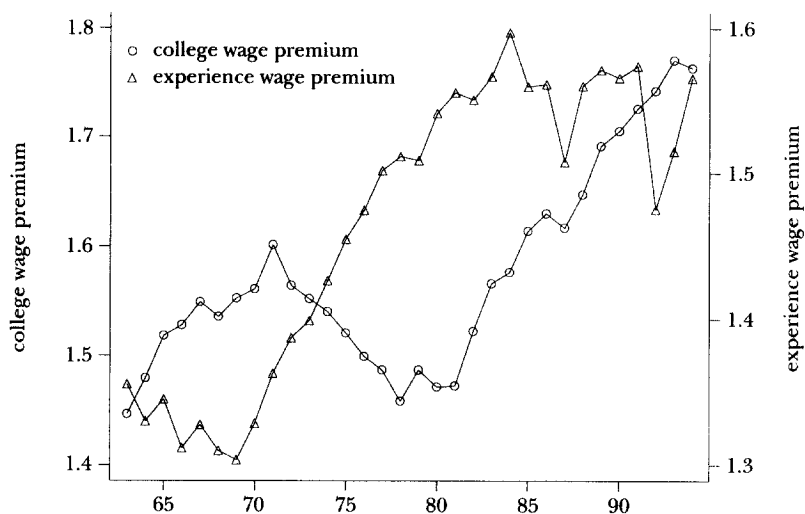
The "college wage premium" line indicated by circles in Figure 2 shows the ratio of average wages for college and high school graduates, which is one measure of the returns on a college education. In 1963, the typical college graduate earned about 45 percent more than did a high school graduate. The college wage premium rose through the 1960s, peaking at about 60 percent in 1971, and then fell throughout the 1970s, returning to 45 percent by the end of the decade. Economists in the late 1970s were concerned that the U.S. labor market was saturated with "over-educated" workers, for whom there was insufficient demand. While it was sensible to forecast that the returns to schooling would rebound from its low level in the late 1970s, as Richard Freeman (1979) did, no one foresaw the amazing magnitude of the increase in the college wage premium, which rose to nearly 80 percent in the early 1990s.[1] As we will see below, the decline in the returns on a college education that occurred in the 1970s was driven by a rapid expansion in the supply of educated workers. Growth in the supply of this particular skill outstripped demand, so price fell. This helps to explain why the 90–50 wage differential was mainly unchanged before 1980: among high-wage workers the declining returns to college education largely offset the increasing returns to other, unobserved, dimensions of skill.[2]

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[1] Except me. I started as a newly minted assistant professor in 1979, when the returns to education were at their lowest. Though I can't remember how I knew it, my behavior shows that I did know the investment would pay off.

[2] As evidence of this, think of a wage regression that controls for observable characteristics of person i; say, $\log(\text{wage}_i) = X_i\beta + \varepsilon_i$. Variables in X include education, experience, and so on. Treat the residuals

The "experience wage premium" line indicated by triangles in Figure 2 shows the returns to experience, estimated as the ratio of average wages for "peak earners" with 25–35 years of labor market experience to "recent entrants" with 0–10 years of experience. Learning by doing and on-the-job training cause skills to accumulate with time spent working, so rising demand for skilled labor should raise the returns to experience. The figure shows that this has occurred. The wage premium for experienced workers rose steadily from about 30 percent in the late 1960s to 55 percent by the early 1980s, where it has stayed since then.

Notice that the increase in the returns to schooling lags behind the rise in the returns to experience, as well as behind the general increase in wage inequality shown in Figure 1. This occurred because large numbers of college-educated workers entered the labor market in the early 1970s, reducing their relative wages. Though changes in the returns to education and experience show differences in timing, in both cases the data indicate that the returns to skill increased. These changes are ingredients of the overall trend toward rising inequality.

A Supply and Demand Framework

Since the growth of wage inequality has been accompanied by growth in the returns to various measures of skill, such as education and experience, it is natural to think of changing inequality in a supply and demand framework. What labor market events might raise the relative wage of skilled workers, and so cause wage inequality to increase?

To fix ideas with the simplest possible model, consider an economy with only two worker types: high skilled (H) and low skilled (L). In this economy, changes in wage inequality can be measured by changes in the relative wage premium earned by high-skill workers, say W_H/W_L. The supplies of high-skilled and low-skilled labor can be viewed as relatively fixed in the short run, but adjustable over time through training and other types of human capital investments. Relative wages will be determined by relative productivities of the two factors, which depend in turn on the relative supplies of the factors and on the state of technology. In this framework, changes in the relative wage premium earned by high-skilled workers are driven by two forces: changes in the relative supplies of high-skill and low-skill workers, and technical changes that raise the relative demand for high-skill workers.

The effect of changes in supply on the wage gap is straightforward. If aggregate output is produced by the two kinds of labor with a constant returns to scale technology, then equal proportional growth in the supply of each skill group leaves their relative wages unchanged. But if the stock of high-skill labor grows proportionally faster than does the stock of low skill, then the monetary returns to skill,

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from this regression as the value of "unobservable" skills. If we compute the 90–50 and 50–10 wage differentials from the residuals, both rise throughout the 1970s. This suggests that rising inequality in unobservable skills was partially offset by declining returns to college, reducing the 90–50 differential in the 1970s.

W_H/W_L, will fall. This effect of changing factor proportions on relative wages is smaller the greater is the ease of substitution between high-skilled and low-skilled workers. For example, let "high-skill" workers be college educated and "low-skill" workers be those with a high school degree. Let s be the elasticity of substitution between high- and low-skilled labor in aggregate production. Then if $s = 1$ (as in a Cobb-Douglas technology), a 10 percent increase in the relative number of college graduates will reduce the college wage premium by 10 percentage points. If $s = 2$, however, the same change in supply would reduce the college premium by only 5 percentage points, because the demand for college-educated labor is more elastic. The point to notice is that as the elasticity of substitution in production rises, changes in supply have a smaller impact on wage inequality.

Technical change, the other driving force in this model, alters the demand for the two kinds of labor by changing their relative productivities. Holding the rates of growth in factor supplies fixed, technical innovations that raise the relative demand for skilled labor also raise the relative wage of high-skill workers, W_H/W_L. The result is an increase in wage inequality. Unfortunately for empirical studies, changes in technology—which are embedded in the aggregate production function—are not directly observable or measurable. In empirical practice, this means that "technical change" is typically *defined* to be the amount of the change in relative wages that cannot be explained by observable things; that is, it is the econometric residual in a model of wage determination. This fact makes it nearly impossible for this theory to fail. Any movements in inequality that are unexplained by net supply variables can be attributed to "technical changes" that have shifted the demands for low-skill and high-skill labor at different rates.

An example may clarify this point. During the past several decades, all advanced industrial societies have experienced rising average skill levels, as successive cohorts of workers enter the labor force with higher levels of educational attainment. Absent technical change that generates increased demand for skills, the returns to education should fall as educated workers become more plentiful. Yet in the United States and other advanced countries, the returns to education have been rising since about 1980, as shown in Figure 2. Thus, many economists infer (without direct evidence) that shifts in the relative demand for skilled workers—generated by technical change—have outpaced rising supply, so that the high-skill wage premium has increased.

This basic framework can take us a good distance; variants and extensions of this approach have been applied in a number of contexts, including the impact of the baby boom on the wages of young workers, the effects of immigration on the wages of immigrants and natives, and the effects of rising education levels on the relative wages of college graduates. These applications will be discussed below. However, the model is seriously deficient in one regard. Since it is founded on a one-sector model of aggregate production, it neglects changes in the relative demand for factors that flow from changes in product demands. For example, suppose that reductions in barriers to international trade reduce the prices of goods, like textile products and clothing, that disproportionately employ low-skilled labor. U.S. production of these goods will fall, which reduces

the domestic demand for low-skilled labor. Wage inequality will rise. Similarly, a change in consumers' demands that favors skill-intensive products will also cause inequality to rise.

The analysis can be readily extended to incorporate these effects.[3] Let there be many industries, or sectors, each using high-skill and low-skill labor in constant returns to scale production. It remains true that greater ease of substitution reduces the impact of supply changes on relative wages and inequality. When demand for a factor is highly elastic, supply shifts don't change relative wages very much. More importantly, the extended analysis introduces another possible reason for a shift in relative demand for a particular type of labor. An increase in the relative output of the sector that relies more heavily on high-skilled labor will raise the relative demand for skilled workers, which in turn increases wage inequality.

To summarize this discussion, the changes in market forces that drive changes in relative wages can be divided into three categories: i) changes in relative supply of different kinds of labor, or changes in factor proportions; ii) changes in the relative demand for labor that are driven by changes in the composition of product demands; and iii) changes in relative demand for labor that are driven by technical change, which are measured as a residual. My main focus in this paper is on relative supply, but it is impossible to talk about supply-side factors in isolation.

Factors that Affect Inequality

With few exceptions, the consensus in the literature is that technical change favoring high-skill workers has been an ongoing force toward rising inequality in developed economies, at least for the last 25 years.[4] Against this background of

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[3] The basic framework for understanding the evolution of wage inequality in a two-sector model can be expressed

$$w_H - w_L = -\frac{1}{s}\left[(x_H - x_L) - (y_H - y_L)\right] + B,$$

where all quantities are expressed as proportional rates of change. For example, $w_H - w_L$ is the difference in the rates of wage growth between high-skilled and low-skilled workers; $S > 0$ is an index of substitution possibilities between type H and type L workers; $x_H - x_L$ is the rate of change in the ratio of high- to low-skill workers; $y_H - y_L$ is an index of relative demand growth for the two labor types; and B represents biased technical change that increases the relative demand for type H labor. More specifically, S is an employment-weighted average of labor demand elasticities from sectors 1 and 2. To understand the y terms more fully, denote the rate of change in the output of industry 1 by y^1 and the rate of change in industry 2 output by y^2. Given these changes in output, the rate of increase in the demand for each worker type is $y_H = K_H^1 y^1 + (1 - K_H^1)y^2$ and $y_L = K_L^1 y^1 + (1 - K_L^1)y^2$, where K_H^1 is the proportion of aggregate high-skill labor that works in industry 1, and K_L^1 is the proportion of low-skill labor that works in industry 1. Notice that the relative demand index $y_H - y_L$ is measurable so long as output is observable. Since x and y are measured in the same units, we can think of the bracketed term as a measurable index of the "relative net supply" of skilled labor.

[4] For example, see Katz and Murphy (1992), Bound and Johnson (1992) and Murphy and Welch (1993). An exception is Mishel and Bernstein (1996).

rising relative demand for skills, forces that change the supplies of various skills serve either to mitigate or exacerbate rising wage differences. For example, a key policy concern about immigration is that it reinforces the trend toward rising inequality, while investments in education are thought to offset this trend. A number of supply and demand factors are taken up in more detail below. On the supply side, factors that change the skill composition of the labor force include immigration, changes in the size of birth cohorts, education and increased labor force participation by women. Measurable factors affecting labor demand—which excludes technical change—are changes in product demands and reductions in trade barriers. I treat these issues in turn.

Immigration

Source countries for immigration to the United States shifted during the 1970s and 1980s, leading to increased flows of low-skilled immigrants from Latin America and Asia. It is at least plausible that a rising supply of low-skilled workers will push down their wages, leading to greater inequality.

With constant returns to scale, a proportional increase in all inputs will leave per capita income and its distribution unchanged. Immigration is a public policy issue precisely because it alters factor ratios, and so it can alter relative prices and the distribution of income. For example, labor unions commonly advocate stronger immigration (and import) controls because immigrants are thought to compete in the labor market with blue-collar union workers. In contrast, owners of capital will generally gain from increased immigration; thus the editorial page of the *Wall Street Journal* advocates more open immigration policies. Given a public policy concern over income inequality, evidence that new immigrants compete in the labor market with less-skilled natives would strengthen the argument for stricter immigration controls.

Attempts to estimate the impact of immigration on wages treat the arrival of new immigrants as an exogenous shift in the supply of labor. Extending the basic model set out above, wage adjustments among native workers depend on the size of immigrant flows as well as on the own-price elasticity of demand for immigrant labor and the cross-price elasticity of demand for native labor with respect to the price of immigrant labor—that is, on how well immigrants substitute for natives for natives in production.

At first blush, one might expect the effects of immigration to be small simply because immigrants do not contribute much to aggregate labor supply in most industrialized countries. For example, during the 1970s, immigrants added about 2 million people to the American workforce while roughly 20 million new native workers entered the labor force because of the baby boom and increased labor force participation by women. Even the slightly larger immigration flows of the 1980s raised the immigrant proportion of overall labor supply by only 1 percentage point, to 8 percent (LaLonde and Topel, forthcoming; Meisenheimer, 1992). These magnitudes can be taken to mean that immigration is unlikely to have large effects on the overall distribution of wages.

The counterargument is that immigrant populations are heavily concentrated

in particular geographic areas and among less-skilled workers. New immigrants tend to congregate in "enclaves" where large populations of previous immigrants and ethnically similar natives reside. For example, during the 1970s new (mainly Hispanic) immigrants increased labor supply in metropolitan Los Angeles by over 30 percent, which was two-thirds of total labor force growth in the area. During the same period, immigration to Miami accounted for nearly 40 percent of labor force growth (LaLonde and Topel, 1989). The 1980 "Mariel boatlift" of mainly low-skill Cuban refugees to Miami increased the local labor force by 7 percent in less than a year (Card, 1990). The size of these changes suggests that immigration may substantially impact wages in local labor markets, at least in the short run when other factors of production are inelastically supplied to a locale. Further, any effects of immigration on local wages should be largest among natives whose skills substitute well for those of immigrants. Young Hispanics and blacks in Los Angeles or Miami, who often have lower education and experience levels, are prime candidates.

However, the weight of the empirical evidence is that immigration to the United States has not contributed much to reducing wages for low-skilled native workers nor to changes in overall wage inequality. For example, my papers with Robert LaLonde (1989) and LaLonde and Hojvat-Gallin (1995) evaluate the impact of immigration on wages in local labor markets. Using data from the U.S. Censuses of 1970, 1980 and 1990, we find that new immigration modestly lowers the wages of recent immigrant cohorts (those in the United States for less than 10 years), but it has little or no impact on other groups, including young native workers and immigrants who have been in the United States for more than 10 years. A doubling of the immigration rate to a local area would reduce the relative wages of new immigrants by less than 3 percent, and of young black natives by less than 1 percent. We also find that labor force participation and unemployment rates of natives are unaffected by immigration; Altonji and Card (1991) reach a similar conclusion. Consistent with these results, Card (1990) finds no discernible effects of the Mariel boatlift on relative wages or unemployment rates in Miami. In a similar study, however, Hunt (1992) finds slightly larger effects of the 1962 repatriation of 900,000 French citizens from Algeria. In her study, a doubling of the repatriate share in a locale reduces wages by 1.3 percent. Of course, this localized effect can hold only for the short run.

Why are the effects of immigration so small? One obvious answer is that geographic mobility of natives offsets the effect of immigration on local factor ratios, so that relative wages don't change by much. Put differently, the labor supply of substitute workers is highly elastic. Consistent with this possibility, Filer (1992) finds that natives migrate away from locales with high immigration flows. Similarly, Card (1990) finds that native migration to Miami fell after the arrival of Cuban refugees. These findings suggest that, at least with regard to immigration, labor markets are not particularly local at all.

I know of only one study that finds a substantial impact of immigration on relative wages and inequality. Oddly enough, given my overall conclusion that immigration has little impact, this evidence is drawn from my own work. In Topel (1993, 1994), I find that between 1972 and 1990, the decline in relative wages of

low-skill men was only half as large in New England as in the far West, which had the largest increase in wage inequality among all U.S. regions. Why the difference? One reason is that the West experienced the largest inflow (as a proportion of the labor force) of low-skill immigrants from Asia and Latin America, especially in the 1980s. Compared to the rest of the country, the relative quantity of low-skilled labor was rising in the West. This caused the wages of low-skill workers to decline more rapidly in the West than they did elsewhere. Keep in mind, however, that even this finding does not mean that immigration is the prime cause of rising wage differences. In my analysis, wage inequality would have risen in the West even if no immigration had occurred. The change in relative wages would simply have been smaller than it was.

Cohort Size

The effects of cohort size on earnings tend to be a sidelight in the inequality literature, but they are worth some mention. Unusually large birth cohorts raise the relative supply of young workers, causing their wages to fall. As young workers have lower relative wages than experienced workers, this may contribute to greater overall wage inequality.

In the United States, the "baby boom" cohort of workers entered the labor market in force in the 1970s. Welch (1979) and Berger (1985) find that the increase in the relative number of young workers that occurred in the 1970s caused their relative wages to fall. Or to put it another way, age-earnings profiles steepened. This change was illustrated in Figure 2, which showed a rising "return" to experience throughout the 1970s.[5] The wage penalty for being a member of a large cohort dissipates as a cohort ages, however, because substitution possibilities across cohorts improve with age. As a contrasting example, South Korea experienced in the 1980s the effects of a "baby bust," when the share of young workers (aged 20–29) fell by 25 percent, while the share of workers over age 50 doubled. As a result, age-earnings profiles flattened in Korea, with the relative wages of young workers rising by about 10 percent (Kim and Topel, 1995).

Education

In the United States and other countries, younger cohorts of workers are more educated than are their parents. Entry of these workers into the labor market reduces the returns to schooling because educated workers become relatively abundant. This reduction in the returns to skill will reduce wage inequality.

Considerable interest has focused on relative numbers of workers with different levels of educational attainment. There are two reasons for this interest. First, education is the most easily quantified empirical measure of "skill," which makes the study of educational wage premia a natural application of the model outlined ear-

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[5] Given other trends in wage inequality, it is difficult to disentangle the steepening of wage profiles generated by cohort effects from the overall rise in the price of skills that may have been caused by technical change. The technical change issue was not considered important at the time that Welch (1979) and Berger (1985) were writing.

lier. However, it should be remembered that education is only one of many dimensions of skill or talent that are valued in the labor market, so changes in the returns to schooling explain only a portion of observed changes in wage inequality.[6] Second, education is commonly viewed as being central to any long-run solution to rising inequality. If skill differences in wages are to narrow in the future, perhaps the only plausible approach is to increase the share of skilled workers in the labor force through education, on-the-job training and other forms of human capital investment.

In recent decades, most industrialized countries have experienced a rapid upgrading of the educational composition of their labor forces, as expansion of public education causes younger cohorts to enter the labor market with more schooling than their predecessors. Table 1 provides three examples. It shows changes in the educational composition of the labor force in Sweden, South Korea and the United States from 1970 to 1990. In each country, the labor force share of those with less than a high school education fell by roughly half in only 20 years. At the same time, the share of college-educated workers rose sharply. Similar patterns of educational upgrading have also occurred in Great Britain, France and Japan (Katz, Loveman and Blanchflower, 1995). Absent offsetting shifts in demand, these changes in educational composition should reduce the returns to schooling and, perhaps, overall wage inequality.

Evidence for the countries in Table 1 indicates that changes in the educational composition of the labor force do affect the returns to schooling. As shown earlier in Figure 2, the returns to a college education in the United States trended downward until 1979 as college enrollments expanded sharply. The rate of increase in the labor force share of college graduates slowed thereafter, which led to rising returns. Using these data, Katz and Murphy (1992) conclude that the elasticity of substitution between American college and high school graduates is about 1.4. Other things constant, this means that a 10 percentage point increase in the ratio of college to high school graduates would reduce the college wage premium by about 7 percent. Goldin and Katz (1996) argue that the wage premium of U.S. high school graduates, compared to nongraduates, fell sharply during the early twentieth century, which they attribute to the rapid increase in the proportion of young people graduating from high school during that period. In Sweden, Edin and Holmlund (1995) conclude that much of the early-1970s decline in the college wage premium, which fell from nearly 60 percent in 1968 to barely 20 percent by 1981, was caused by the increased relative abundance of college graduates. Their estimates imply a much larger impact of factor quantities on wages than in other studies, however, which led Edin and Topel (forthcoming) to conclude that centralized wage-setting institutions in Sweden must also have played a role. In Korean data, Kim and Topel (1995) find that the educational upgrading shown in Table 1 drove a huge decline in the returns to schooling.

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[6] Using the standard deviation of log wages as a measure of wage dispersion, the change in the return to schooling between 1969 and 1994 accounts for about 30 percent of the increase in wage dispersion. For the period from 1979 to 1994, where the returns to schooling trended up, the estimate is 65 percent.

Table 1

Changes in the Educational Composition of the Labor Force, Swedish, South Korean and U.S. Men, 1970–1990

| | *Proportion with Indicated Schooling* | | |
	1970	*1980*	*1990*
Sweden			
Less than high school	.59	.45	.30
High school	.33	.40	.46
Some college	.08	.15	.24
South Korea			
Less than high school	.58	.48	.28
High school	.26	.33	.47
Some college	.16	.19	.25
United States			
Less than high school	.29	.19	.15
High school	.39	.39	.39
Some college	.32	.42	.46

Sources: For the United States, author's tabulations from the Current Population Survey; for Sweden, Edin and Topel (1996); for South Korea, Kim and Topel (1995).

Compared to those with only 9 years of schooling, from 1972 to 1989 the returns to a college education fell by roughly half, and the returns to a high school education fell by over two-thirds.

However, in both the United States and Sweden, the returns to a college education stopped falling and started rising in the early 1980s. Other developed countries show similar patterns of flat or falling returns to college during the 1970s, followed by rising returns during the 1980s (Katz, Loveman and Blanchflower, 1995). If educated workers have become more abundant, and if, as evidence from a variety of sources clearly indicates, greater abundance of skilled workers reduces their relative wages, then why didn't the returns to schooling continue to fall after 1980? Given the supply and demand framework discussed earlier, the answer must be that the supply of educated workers increased faster than demand during the 1970s, but demand growth was greater during the 1980s. The pattern of supply changes in the United States is consistent with this: the labor force share of college graduates increased rapidly in the 1970s, but decelerated in the 1980s. If biased technical change caused relative demand to grow at a constant pace, the returns to a college education would have to rise after 1980.[7]

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[7] In South Korea, the sequence of supply changes is reversed. Greater convergence of skills occurs in the 1980s, which is also the period of greatest decline in wage differentials (Kim and Topel, 1995).

Inequality and Female Labor Force Participation

In many developed economies, female labor force participation has soared during the past 25 years. At the same time, male wage inequality has increased. The median of the female wage distribution falls at about the 25th percentile of the male distribution, which suggests that women may compete in the labor market with relatively low-wage men. Further, most of the increase in female labor supply occurs because participation is high among younger cohorts, who have fewer years of labor market experience. But while it is tempting to look for causation running from this increase in female labor supply to declining wages of less-skilled men, a connection isn't easy to find. For the facts to fit together, it must be the case that these low-experience, high-education women who have entered the labor market are good substitutes for low-skilled men, whose wages fell the most.

Some evidence does suggest that the rising labor supply of women may have been an important contributor to the increase in male wage inequality. In Topel (1993, 1994), I exploited regional differences in changes in female participation to address this issue. Taken literally, my estimates imply the pattern of substitution just described—high-wage women substituting for low-wage men. Further, they imply that if women's participation had not changed, there would have been no decline in the wages of less-skilled men. Juhn and Kim (1995) find a similar pattern of substitution.

The findings are only suggestive, however, and much speaks against them. The pattern of substitution required to make this theory work is somewhat counterintuitive for several reasons. Women who have entered the labor market tend to work in different occupations and industries than the low-skilled men whose wages have fallen, so it is not clear how substitution between these groups occurred. Further, the surge of female labor supply occurred in the 1970s, while men's wages continued to fall through the mid-1980s (Juhn and Kim, 1995). Finally, the increased labor force participation of women coexists with rising relative wages for women. The demand for skills provided by women workers evidently rose even faster than the stock of women in the labor force. But if the demand and price for women's skills were rising, and low-skilled men are alleged to be substitutes for women, then the demand for low-skilled men should have been rising as well.[8] I can only conclude that this topic deserves more work.

Changes in Product Demands as a Source of Rising Inequality

Increases in demand for products that employ more high-skilled workers, or decline in demand for products that employ low-skilled workers, will tend to increase inequality. However, empirical research has found little evidence that changes in the industry composition of demand have had an important effect on relative wages.[9] While demand changes go in the "right" direction, favoring skill-

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[8] A consistent argument is that a decline in discrimination against women allowed them to enter the labor market with rising wages. This reduction in a barrier to trade would put pressure on men's wages.

[9] In the framework in note 3, the terms $y_H - y_L$ represent shifts in the relative demand for high-skilled workers. The equation in note 3 should be considered as a prototype for more complicated specifications of the same idea, which include the empirical work discussed here.

intensive industries, they are small and swamped by changes in the supply of different skill groups. For example, in studying regional differences in wage inequality, I found that the decline of certain industries, like durable goods in the Midwest or trade-sensitive industries generally, had minor effects on wage inequality (Topel, 1993). Similar results were found in aggregate data by Murphy and Welch (1993) and Katz and Murphy (1992) and in Korean data by Kim and Topel (1995). At least in terms of measurable quantities—which leaves out technology, of course—by far the largest part of the story seems to be on the supply (factor proportions) side.

International Trade and Rising Wage Inequality

The United States is an exporter of skill-intensive products and an importer of many goods produced by low-skilled labor. Reductions in barriers to international trade with the developing world have increased the effective supply of goods produced by low-skilled labor. With lower prices of these goods on world markets, domestic production of goods produced by low-skilled labor falls, which could tend to raise wage dispersion. However, as the opening of the economy to trade causes a shift toward its comparative advantage in skill-intensive products, the key parameter will be the elasticity of substitution in production between high-skill and low-skill workers. If substitution between types of labor is difficult, then the share of imports in aggregate income need not rise by much for trade to have a large impact on wages. But if substitution is relatively easy, then trade becomes an implausible candidate for causing greater inequality.

The evidence (mentioned above) is that changes in the skill composition of aggregate output have gone in the direction that would lead to greater inequality, but that changes are quite small. To square this fact with the decline in relative wages of low-skill workers that actually occurred, substitution possibilities would have to be much smaller than current empirical evidence suggests. In other words, given what we know about the magnitude of substitution, shifts in the composition of output are not large enough to make trade a credible culprit in changing the wage structure.

Two final points about trade are relevant. First, if trade causes factor prices to be determined on international markets, and if technical changes have not raised the demand for high-skill labor, then firms and industries would respond to a reduction in the relative price of low-skilled labor. They would substitute toward low-skilled labor. But for the period under study here, factor ratios of skilled to unskilled labor have shifted in favor of more skilled labor in nearly all major industries. In other words, a trade-based explanation predicts substitution toward low-skilled workers, but actual substitution has favored high-skilled workers, even though their relative wages have risen. The idea that trade has caused increased inequality does not square with these facts.

The second point relates to evidence that domestic supply and demand factors seem to matter in the determination of wages. With factor price equalization across international borders, all factor prices would be determined in international markets. Changes in the domestic supply of, say, college-educated workers would not matter much for the determination of relative wages, since each country is small

compared to the relevant market. The same applies to immigration, cohort size and female labor force participation. Yet mounting evidence from a number of countries suggests that changes in domestic factor proportions—especially education and cohort size—do affect domestic wages.

Wage Inequality and Human Capital Investment

Wage inequality has risen in modern economies because rising demands for skills have made talented people more scarce. As in other market situations, this "problem" of a demand-driven rise in price contains the seed of its own solution. Supply is more elastic in the long run than in the short run. Rising returns to skill encourage people to invest in human capital, which in the long run will increase the proportion of skilled workers in the labor force. But does the acquisition of human capital actually respond in this way? Is there room for optimism about future trends in wage inequality?

Consider the market for schooling, the dimension of human capital investment that is directly observable. Given the unprecedented increase in the returns to education that was shown in Figure 2, the public policy debate on whether greater investments in education are socially and privately worthwhile should be over. Yet consider the following perspective, taken from a popular and current defense of America's public schools by two well-known professors of education. Arguing that the "demands for ... highly educated people are declining [!] because of evolving shifts in the labor market," Berliner and Biddle (1995, pp. 100–102, emphasis in original) conclude that fewer young people should go on to college. In their view of the labor market:

> What the country's job market needs most ... [is] a whole lot of people to work at jobs that are not intellectually challenging—driving vehicles of various types; doing typing, word processing, and data entry; cleaning; selling in retail stores; waiting on tables; and providing services for others in need. . . . [E]vidence suggests that we already have *too many* college graduates for the high status jobs that are available. . . . [O]ur country currently has a *surplus* of people with high-level technical qualifications.

By increasing the supply of less-skilled workers, even while the demand for them has been falling, this advice is an ingenious recipe for reducing their wages and making wage inequality greater than it already is.

Fortunately, the schooling decisions of young people are better informed about the demand for educated workers than are these academic authors. First consider Figure 3 taken from Edin and Topel (1996), which shows that college enrollments do respond to declining returns to schooling. The figure graphs the relation between the estimated return to a college education in Sweden on the left-hand scale and the proportion of Swedish men aged 20–24 who are enrolled in school on the right-hand scale. The correspondence is striking. The college

Figure 3

Male School Enrollment and the College Wage Premium in Sweden, 1963–1991
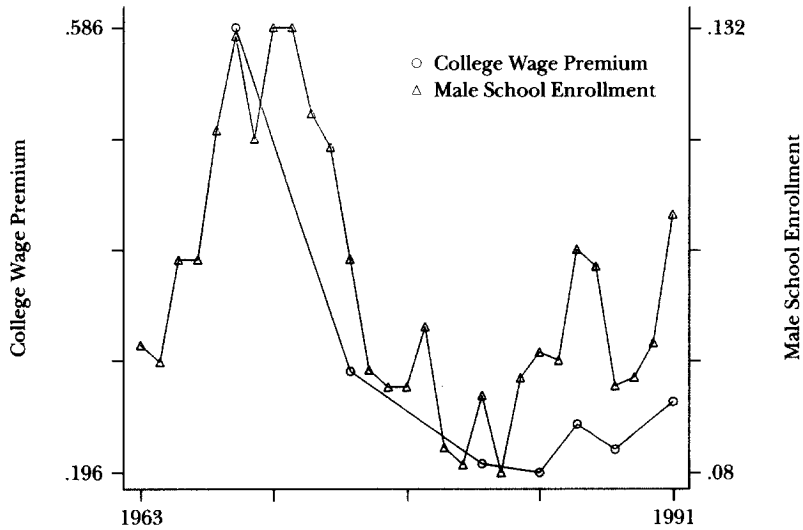

Source: Edin and Topel (1996).

enrollment rate fell by more than half between 1968 and 1981, at the same time that the returns to schooling plummeted. By 1981, the wage premium for a four-year college education was less than 20 percent, or less than half the lowest premium observed in U.S. data. Although both college enrollments and returns to education recovered slightly the 1980s, the returns to education in Sweden remain extraordinarily low.

Figure 4 shows corresponding evidence for American men. The left scale of the figure measures the college/high school wage ratio and the right scale measures the college enrollment rate as the fraction of men aged 20–24 with some college. Again, the correspondence in these two series is striking. As the college/high school wage premium rose through the 1960s, the fraction of young men with some college climbed, peaking at 44 percent in the early 1970s, when the returns to college were at their highest level up to that time. This peak rate of human capital investment fueled the rapid increase in college-educated labor supply in the 1970s, which drove down the college wage premium. As the returns to college fell, so did school attendance, reaching a low of about 37 percent in 1980. Starting around 1980, both the college wage premium and the proportion of young men attending college began to rise, the latter reaching an all-time high of 46 percent in 1992, when the returns to schooling were also at a record high. Similar patterns hold for young women. From 1979 to 1993, the school attendance rate for women aged 19–23 rose from .30 to .41. As in Sweden, the American evidence is that the supply of skilled workers rises with the relative price of skills.

Figure 4
College/High School Wage Ratio and College Enrollments
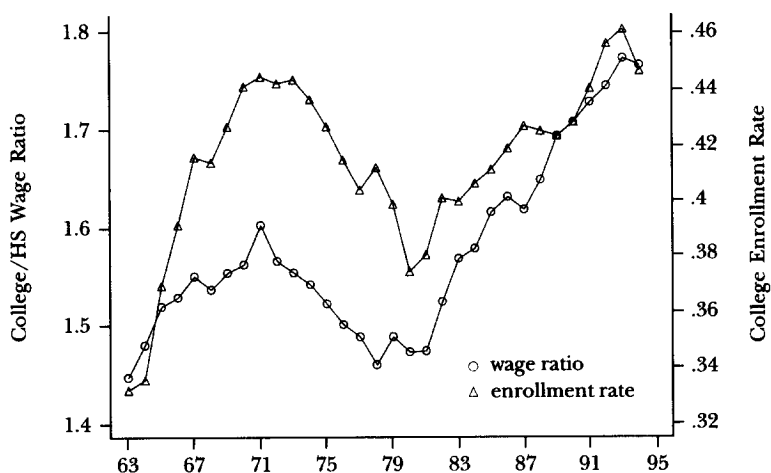
This evidence demonstrates that rising demand for educated workers generates a corresponding increase in quantity supplied, which in the long run will attenuate the growth in the returns to schooling. Furthermore, there is no reason to believe that this behavior is confined to investments in higher education. It will occur in other realms, such as on-the-job training, where the price of skills has risen. Rising stocks of skilled workers in the future, generated by current and future human capital investment, will limit the growth of inequality. This does not imply that inequality will *fall* in the future, only that skill accumulation will limit its growth. There is no evidence yet that the growth in the supply of skilled workers has kept pace with rising demand.

There is also a danger of reaching too far with this evidence. The United States has the premier system of higher education in the world, which encourages individual investment decisions by well-informed adults. This may allow the market for high-level skills to work reasonably well. Yet growth in inequality is at least as severe at the low end of the wage distribution—look again at Figure 1—where the skills that need to be acquired are fairly basic. Production of these skills takes place in many venues, including jobs, elementary and high schools, and in homes and families. Putting on-the-job training to the side, in an era of widespread concern about the quality of public education in the United States, the ability of American schools to supply the skills demanded in a modern workplace is questionable. Put this together with myriad personal and social problems associated with the growth of single-parent, low-income families, and it is hard to be sanguine about prospects for human capital investment among less-skilled workers. Indeed, the social pathologies of poverty, which are partly

caused by rising inequality, may themselves be impediments to human capital investment in low-income households.

As a final point, it is worth mentioning that human capital investment can reduce overall inequality even in the absence of wage adjustments. Educational improvements among the least skilled, for example, equalize the stocks of human capital that workers bring to the labor market. This equalization of opportunity can be even more important than equalization of wages, holding stocks of human capital fixed. For example, referring back to our discussion of trade, investment in human capital would reduce inequality *even if* factor price equalization made wages exogenous to the domestic labor market.

Concluding Remarks

Rising wage inequality is one of the most important social changes in modern economic history. The weight of empirical evidence is that this change in the wage structure is demand-driven, emanating from technical changes that have favored skilled labor in production. The skill composition of the American workforce has also improved over time, but to date this increase in the supply of skills has not kept pace with rising demand.

Interest in the effects of changes in supply on wage inequality comes from two basic sources. First, with technical changes that have caused a secular increase in the demand for skilled labor, certain supply changes can exacerbate the resulting trend toward rising skill differences in wages. Increased immigration and rising female labor force participation are the prime examples of such supply factors. Most studies of immigration find effects that are too small to be of much concern, though there is evidence that Asian and Hispanic immigrants have reduced native wages in the western United States. Research on the impact of female labor supply is more limited. It may well be that the entry of women into the labor force had a substantial impact on male wage inequality, but this explanation requires that new female workers—who tend to be more skilled than women from earlier periods—substitute easily for low-skill men. Overall, existing research is not dispositive on whether supply factors have been major contributors to rising inequality.

The second reason for interest in supply effects stems from the hope that human capital investment will mitigate future inequality. Increased demand for skilled people is unlikely to abate anytime soon, so the supply of skilled people must expand if the skill gap in wages is to narrow. Evidence on college attendance rates is encouraging in this regard: as the returns to college have risen, more young people have chosen to go to college. But college education is only one element of the myriad skills that are valued in the labor market. Perhaps other human capital investments—ranging from improved elementary education to on-the-job training—have also risen, but evidence is meager. Further, an increase in the stock of college-educated labor will have its main impact in the upper reaches of the wage distribution, because highly skilled workers will be

more plentiful. Yet the social pathologies of rising inequality—poverty, crime, reduced employment, and so on—are concentrated among the least skilled members of society, whose wages have steadily fallen. Opportunities to improve the skills of these workers fall more heavily in the realm of public policies, such as improving the quality of public education. Unfortunately, there is little evidence that current policies affecting the least skilled are effective, and even less agreement on what might make them so.

What does this mean for the future? If skill-biased technical change is the underlying cause of rising inequality, then policy options for reducing inequality are severely limited. The demand for low-wage American men will not improve on its own, so the solution is to affect supply through education and training. Even if we assume that private and public decisions respond to the demand for greater skills, however, the flow of such investments will only slowly reduce the stock of low-skilled labor. Under these conditions, wage inequality close to the levels that we observe today will be with us for the indefinite future.

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