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Changes in Earnings Inequality: The Role of Demand Shifts

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There is a rapidly growing literature in economics dealing with the causes of the increase in earnings inequality over the last few decades. Surveys of the early work in this area are provided by Levy and Murnane (1992) and Brauer and Hickok (1995). This literature reaches virtually unanimous agreement that during the 1980s relative demand increased for workers at the high end of the skill distribution and thus caused their relative wages to rise. Since highly skilled workers were already at the high end of the wage distribution, earnings inequality increased. This paper first considers the rationale behind the consensus that a demand shift has occurred and then explores the possible factors that could have been responsible for the demand shift.

The Indirect Argument for a Shift in Demand

The argument that a shift in the demand for high-skilled labor has played a leading role in the growth of earnings inequality begins with an observation about the relative supply of high-skilled labor. By any measure, simple or complex, the workforce has become more skilled in the last few decades. As a simple measure, the fraction of the adult population (those over 24) who had completed college rose from 11 percent in 1970 to 16 percent in 1979 to 21 percent in 1989, as shown in the fourth column of Table 1.

A more complex measure of the overall skill level of the population is based on a conversion of all persons in the population into college and high school

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Table 1
Educational Distributions of the U.S. Adult Population, Selected Years 1940–1993

	Percentage Distribution				
Year	*<High School*	*High School*	*Some College*	*College+*	*Relative Skill Supply*
1940	76	14	5	5	.105
1950	66	21	7	6	.137
1963	52	30	9	9	.185
1970	45	34	10	11	.217
1979	32	37	15	16	.333
1989	23	39	17	21	.435
1993	20	35	23	22	.496

"equivalents." High school equivalent (potential) labor is the sum of a series of calculations. The number of individuals with less than 12 years of schooling is multiplied by the ratio of the average year-round, full-time wage of 35- to 44-year-old males with less than 12 years of schooling to the wage of that group with exactly 12 years of schooling; this calculation has the effect of giving high school "dropouts" a lower weight than their actual number. To this total, add the number of those who have exactly 12 years of schooling. Then, take half of those who have some college background but did not complete a four-year degree, and, again, multiply their number by the ratio of the wage of 35- to 44-year-old males with some college to that of high school graduates; this adjustment has the effect of giving this group a greater weight than (half of) its actual number. College equivalent labor is equal to the total number of adults with four or more years of schooling plus one half of the number with some college multiplied by the 1993 ratio of the full-time wage of 35–44 year old males with some college to those with four or more years of college. The ratio of college equivalent labor to high school equivalent labor is reported for selected years under "Relative Skill Supply" in the last column of Table 1.[1]

It seems likely that the demand for workers with a particular skill level is downward-sloping with respect to its wage, rather than perfectly elastic. In fact, this must be true as long as workers with high and low levels of education—respectively, "skilled" and "unskilled" labor—are not perfect substitutes for each other. With

[1] In the form described in the text, this index explicitly assumes that workers with less than a high school education are perfectly substitutable for those with only a high school degree, albeit at a lower wage. It also makes a similarly simplifying assumption about the allocation of labor with some college between high (college) and low (high school) skilled labor inputs. Such an index is admittedly oversimplified, but it leads to much the same conclusions with respect to the issues in this paper as a more general, disaggregated approach.

Table 2

Average Annual Percentage Rates of Growth of College/High School Relative Wages, Supplies, and Demand and in Average Aggregate Real Compensation, 1940–1993

Period	*Relative Wage*[a] *(R)* *(a)*	*Relative Supply* *(b)*	*Demand Shift* *(c)*	*Average Real Wage*[b] *(d)*	*Due to Education* *(e)*
1940–1950	−1.3	2.6	0.7	1.7	0.7
1950–1963	0.6	2.4	3.3	2.8	0.7
1963–1970	0.8	2.3	3.6	2.5	0.7
1970–1979	−0.7	4.8	3.7	1.7	1.0
1979–1989	1.3	2.7	4.7	0.4	0.6
1989–1993	1.1	3.3	5.0	0.8	0.6

[a] Goldin and Margo (1992) for 1940–1963; Katz and Murphy (1992) for 1963–1970; Murphy (1996) for 1970–1993.

[b] Rates of growth manufacturing wage for 1940–1950 and of compensation per hour in private business for 1950–1993 less rate of growth of the consumption deflator.

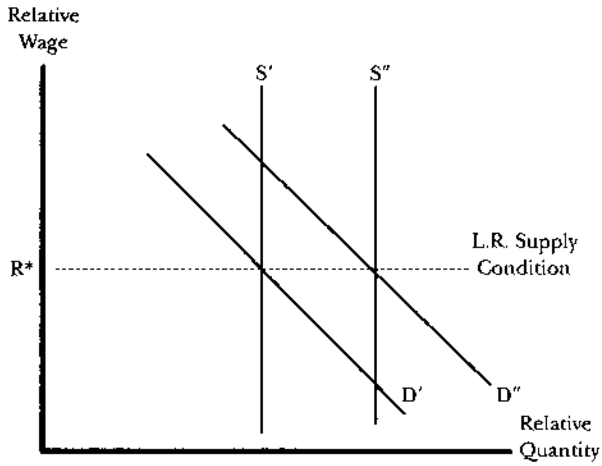
a stable downward-sloping demand for labor function and a shift toward a greater supply of unskilled labor, a textbook application of supply and demand would predict that the relative wages of high-skilled relative to low-skilled labor should have been declining during the 1970s and 1980s.

However, this prediction would be correct only at certain times. Table 2 shows how one important measure of inequality, the ratio of the wages rates of college-educated workers to high school–educated workers (R), has changed over time. While this relative wage did fall during the 1970s, it increased, as shown in the first column of Table 2, at an annual rate of 1.3 percent from 1979 to 1989 and seems to be continuing to increase in the 1990s.

This rise in the wage premium for skilled labor is typically understood with a conventional supply and demand model as the result in a large rightward shift in the demand function. Figure 1 shows the relative quantity of skilled and unskilled labor on the horizontal axis and the relative wage of skilled to unskilled labor on the vertical axis. The short-run relative supply function shifted from S' to S'', but the shift in the relative demand function was significantly greater than that from D' to D''. Thus, R rose above its run equilibrium value R^*. The conclusion that the relative demand function shifted during the 1980s holds for every conceivable method of aggregating different types of labor in a production function context (Bound and Johnson, 1992; Katz and Murphy, 1992; Murphy and Welch, 1992).

Under a tractable and commonly used set of assumptions, changes in the value of wage gap between high- and low-skilled labor will be determined by changes in relative demand and supply, as well as by a parameter reflecting the degree of substitution between the two types of labor. A standard relationship in this literature is

Figure 1
Determination of the Skilled/Unskilled Relative Wage Rate with Simultaneous Shifts in Demand and Short-Run Supply Functions



$$\frac{\Delta R}{R} = \frac{1}{\sigma}\left[\frac{\Delta A}{A} - \frac{\Delta S}{S}\right].$$

R is the relative wage between two groups, in this case college and high school labor, and $\Delta R/R$ is its proportional change over a particular period. S is our measure of the relative supply of college to high school labor, the "Relative Skill Supply" numbers reported in the last column of Table 1. A is a parameter that reflects conditions concerning the relative demand for labor by skill, and an observation that $\Delta A/A$ is positive over a particular time period means that the relative demand function in Figure 1 is shifting right—for whatever reasons. The elasticity of substitution between the two kinds of labor is σ. If there is a high degree of substitution between labor with different levels of skill (reflecting, to take an extreme example, the case in which a heart bypass operation could be led equally well by one M.D. or by five high school dropouts), then changes in relative supply and demand will have only a small influence on wages.[2]

Most estimates of σ are in the neighborhood of 1.5, and I assume that this is its value. Taken with the estimates of proportional changes in the wage ratio and the relative supply of labor by skill in Tables 1 and 2, this allows us to estimate the

[2] Key assumptions underlying this approach include full employment (most of the time), so that relative supply equals relative demand. This requires that R is free to adjust (a condition that is apparently not satisfied in much of western Europe in recent years). Also, relative supply must be viewed as an exogenous variable, depending on past educational investment decisions. In this situation, the value of the relative wage R will be determined by $S=AR^{-\sigma}$, where S is relative supply, A is the demand shift parameter, and σ is the elasticity of substitution between high- and low-skilled labor.

extent to which the relative demand for higher-skilled labor has been shifting. In the 1980s, $\Delta R/R$ was 1.3 percent per annum and $\Delta S/S$ was 2.7 percent, which means that the rate of growth of the demand shift parameter, $\Delta A/A$, was 4.7 percent. In other words, over this 10-year period the relative demand function in Figure 1 shifted to the right by 1.047^{10}, which is an increase of about 60 percent. To put it another way, relative supply would also have to have grown by 60 percent for the college/high school relative wage to have remained fixed from 1979 to 1989. Since relative supply only increased by 31 percent, the college/high relative wage—and earnings inequality generally—rose sharply during the 1980s.

The calculated values of $\Delta A/A$, the average annual rate of growth in the demand shift parameter, are reported for the other subperiods in column *c* of Table 2. An obvious conclusion is that the phenomenon of a shifting relative demand function, although slightly stronger than in the preceding 30 years, was *not* first observed in the 1980s.[3] The upward shift in the educational distribution (from less than high school toward college) has been fairly steady over the past half century, but the college/high school relative wage was fairly stable. The calculated values of $\Delta A/A$ are quite large in each of the periods after the 1940s.[4] Thus, the 1980s—and the first part of the 1990s—may be interpreted as a slight acceleration of a long-term trend rather than as something entirely new.

The focus of this paper is on the demand side, but supply factors are obviously of equal potential importance.[5] The huge increase in the relative supply of college-educated labor in the 1970s, resulting from the spurt in college enrollments during the latter half of the 1960s, which in turn was largely due to the demand for educational deferments from military service, caused *R* to fall by a total of 5 percent during that period. Similarly, the apparent recent acceleration in the rate of growth of the relative supply of college labor, probably induced by the very high observed rate of return to educational investment, has slightly moderated the rate of growth in *R* from 1989 to 1993.[6]

[3] For an earlier discussion of this relative demand shift, see the seminal paper by Welch (1970).

[4] The 1940s was a somewhat unique decade in terms of the industrial development of the United States, in that there was a tremendous growth in blue-collar jobs (to produce Sherman tanks, Studebakers, etc.). Despite these structural changes, the relative demand function shifted to the right by 7 percent. For a perceptive analysis of the evolution of the wage structure during this period, see Goldin and Margo (1992).

[5] Other potential explanations of the rise in *R* include institutional factors, like the decline in unionism and the reduction in the real minimum wage, and changes in the relative labor quality of different labor groups. Although these explanations have their adherents—see, for example, the paper by Fortin and Lemieux in this symposium for a discussion of institutional factors—it is very difficult to generate the large increase in *R* observed during the 1980s by appeal to them. However, one wage development of the post-1980 period, the 1 percentage point per year increase in the average wage of women relative to men, is to a large extent the result of a change in relative labor quality, largely reflecting an increase in the average woman's attachment to the labor force.

[6] Another supply factor that has been going in the other direction is the large rate of immigration of unskilled workers into the United States, which had the effect of lowering *S*. Due to the "undocumented" nature of much of the immigration, this effect could be larger than the CPS data suggest. See Borjas, Freeman and Katz (1996) and Jaeger (1995).

The Causes of the Demand Shifts

The literature offers two major sets of explanations for why the relative demand for skilled workers in the United States increased so rapidly during the 1980s: the increased openness of the U.S. economy and skill-biased technological change.[7] Although these (and other) potential explanations are not mutually exclusive, many papers on increasing inequality have focused on only one of them.

Increased Openness

The rise in earnings inequality in the United States during the 1980s coincided with the huge increase in the trade deficit. This pointed several investigators toward "trade" as the major explanation of demand shifts (for example, Borjas and Ramey, 1994). More generally, since the 1960s, there has been a "globalization" of the U.S. economy, due to improved transportation, technology transfers and the absence of major wars, such that a wide range of manufactured goods can be imported at a lower price than they would obtain if they were produced domestically. To the extent that the goods displaced through this process were produced with a relatively high intensity of unskilled labor, increased openness will increase the relative demand for skilled labor. The potential displacement of low-skilled U.S. labor can also be seen in the emergence of the practice of "outsourcing" by many manufacturing firms, in which many unskilled labor functions are set up in low-wage countries (notably Mexico), leaving only their "headquarters" functions in the United States.

The mechanism by which increased openness would affect the value of the skilled/unskilled relative wage follows three steps: the distribution of tradeable goods produced domestically would shift away from unskilled-intensive toward skill-intensive goods, which forces many unskilled workers to crowd into the nontradeable sector, thus causing a decline in their relative wages. This process was the subject of a recent symposium in this journal,[8] so I will not survey the evidence in detail. There are, however, several problems with the assignment of a major role of openness in the explanation the 1980s wage developments in the United States.

First, the share of total unskilled employment that would be employed in the tradeable goods sector without the adverse international developments is simply too small to have produced relative demand shifts of the magnitude observed during the 1980s. Second, it appears that relative demand shifts toward skilled workers—although slightly greater in manufacturing—took place in *all* industries,

[7] Another explanation of demand shifts, which has received considerable recent public attention is the increasing return to "superstardom" (Rosen, 1981; Frank and Cook, 1995). To a large extent, this phenomenon is the result of technological innovations. Further, although this approach helps to understand some interesting things—for example, why Sylvester Stallone earns so much per movie—it is not likely to apply to the mass of occupations that determine the average college/high school relative wage, like the wages of insurance agents versus tool and die makers.

[8] See Freeman (1995), Richardson (1995) and Wood (1995) in the Summer 1995 issue of this journal. The last of these papers takes the position that increased openness has been a very important factor in the rise in earnings inequality.

tradeable and nontradeable. Most analysts have accordingly concluded that the source of most of the observed relative demand shift was something other than trade. A final reason for skepticism concerning increased openness as the major explanation of the shift of the relative demand function in the 1980s is that the demand function has been shifting fairly consistently for at least 40 years, as seen in column *c* of Table 2. The 1980s—and, by my calculations on the initial data, the 1990s—are simply a slight acceleration of a long-term trend. If international factors were the primary cause of the relative demand shifts, one would not have observed large values of $\Delta A/A$ before the onset of globalization in the 1970s.

Skill-Biased Technological Change

The lack of evidence in favor of trade as an explanation of shifts in the relative demand function during the 1980s led many of the early researchers to the conclusion that something else must have shifted the aggregate production function in favor of skilled workers. Within a conventional supply-demand model, the only plausible candidate that could have done this is skill-biased technological change. Admittedly, the preliminary conclusion that technological change caused the relative demand shifts was somewhat tautological: a) it must have been X_1, X_2, or X_3; b) it was not X_2 or X_3; c) ergo, it was X_1.

A useful way to think about the way technology might affect the demand for different types of labor is to posit that the aggregate flow of labor services is a function of the effective labor input in each of a large number of jobs.[9] Suppose that all jobs can be arrayed from the most complex (neurosurgeon, game theorist) to the least complex (ditch digger, economic consultant). Let us, for the sake of simplicity, also make the dichotomous assumption that each worker is either skilled or unskilled. If skilled workers have a comparative advantage in the more-complex jobs and unskilled workers a comparative advantage in the less-complex jobs, then unskilled workers will fill the less-complex jobs and skilled workers will fill the rest. In this model, the skilled/unskilled relative wage will equal the relative efficiency at which firms are indifferent between hiring a skilled or an unskilled worker in the "marginal" job, and it will be determined by both the relative number of skilled and unskilled workers and by the distribution of how skill pays off in the jobs that exist. An increase in the relative supply of skilled labor causes (after the appropriate adjustment period) a switch in the staffing of some jobs from unskilled to skilled, which means that the marginal skilled worker will receive less and the marginal unskilled worker more, so that the skilled/unskilled wage ratio will fall. This is the intuitive basis for assuming that the substitution elasticity, σ, is finite.

Over time, changes in production techniques may shift the level and distribution of the potential productivity of workers of different skill levels in each of the jobs in the economy. The shifts that can occur are usefully classified in terms of who becomes more productive in which sort of jobs. As a first example, the recent

[9] For a formal exposition of the model that follows, see Johnson and Stafford (1996).

widespread adoption of personal computers throughout most of the economy certainly increased the productivity of most workers that were already in skilled jobs. This is an example of *intensive* skill-biased technological change—skilled workers become more productive in jobs they already perform. A second example, the use of robotics in manufacturing, can be classified as *extensive* skill-biased technological change—skilled workers become more efficient in jobs that were formerly done by unskilled workers, as the use of robots complicated many tasks that had previously been routine. Third, an innovation could increase the efficiency of all groups proportionally, causing no shifts between jobs but simply raising everyone's productivity by the same percentage; this is skill-neutral technological change.[10] A final example, the introduction of the assembly line, probably caused a shift from skilled toward unskilled labor, because of its emphasis on simple, repetitive tasks that required raw labor rather than human capital. Thus, unskilled labor became more productive in jobs that had previously used a higher skill level.

Changes in the relative demand shift parameter—that is, $\Delta A/A$ in the earlier display equation—primarily reflect extensive technological change. Intensive skill-biased technological change will only increase the relative demand for skilled labor to the extent that the elasticity of substitution between the two types of labor, σ, is greater than one. However, even if $\sigma > 1$ (which is very likely), the real wage rate of unskilled labor will rise as skilled labor becomes better at what it normally does.

Extensive technological change causes a shift to the right in the relative demand function, regardless of the value of the substitution parameter σ. In the case of the introduction of robotics techniques, for example, there is a greater demand for skilled workers as engineers, which drives up the skilled real wage rate for game theorists as well as engineers. The "displaced" unskilled assembly line workers have to transfer to the remaining jobs for which they qualify, causing a lower wage rate for ditch diggers. Accordingly, the increase in the relative demand shift parameter, $\Delta A/A$, is much greater for a given increase in aggregate output under intensive than under extensive technological change. Skill-neutral technological change, of course, has no effect on the relative demand for labor A; instead, all boats rise proportionally in this case.

Evidence on Technological Change

The early evidence on the importance of technological change as a source of the shifts in the relative demand for different types of labor during the 1980s

[10] A great deal of emphasis in the literature on this topic is in terms of the hypothesis of a relative complementarity between skilled labor and capital (Griliches, 1969). In terms of an aggregate production function, $Y = F(N_U, N_S, K)$, where K is capital input, this means that the ratio of the marginal products of the two types of labor, say $R = F_S/F_U$, will depend positively on K, and the value of $\Delta A/A$ in the display equation above will be positively associated with the rate of growth of capital per worker. For an insightful analysis of this hypothesis in an historical context, see Goldin and Katz (1996).

came from case studies. The Bureau of Labor Statistics conducted several case studies of the effects of changes in production processes in particular industries (Mark, 1987). In an industry that experienced a significant change in technology, the usual pattern was a dramatic reduction in the employment of production workers with an increase or no change in the number of skilled workers in that industry. More recently there have been several econometric analyses of the effects of variables like the (appropriately lagged) rate of investment in computers and/or other forms of "information capital" and the ratio of expenditures on research and development to sales on changes in the skill composition of industries (for example, Berman, Bound and Griliches, 1994). The results of these studies are consistent with those of the case studies and the hypothesis that the recent technological change has shifted the relative demand for skills function to the right. Further, they point to the likelihood that this technological change was extensive rather than intensive or neutral—"upskilling," in the jargon of this new literature.

Profound changes in production techniques would spill across national boundaries fairly quickly, especially given the prevalence of multinational firms. Thus, *if* technological change is an important determinant of relative demand shifts, one would expect to observe patterns in other industrialized countries similar to those in the United States. Some of the recent studies report results for a variety of old industrialized (OECD) countries that are indeed consistent with the U.S. results (Collechia and Papaconstantinou, 1996; Machin, Ryan and Van Reenan, 1996). These countries vary a great deal with respect to changes in their situations with respect to trade, labor market institutions (like the importance of trade unions), and unemployment. That the relative demand for skilled labor in each of them is rising rapidly is, in my view, fairly strong evidence in favor of the skill-biased technological change story.

A factor that is often cited as the specific cause of the post-1980 spurt in the rate of extensive skill-biased technological change is the widespread adoption of computer technology throughout the economy.[11] As mentioned above, the rate of upskilling has tended to be greatest in those industries with the highest rate of investment in computers. There is also evidence that workers who use computers on the job have, other characteristics held constant, higher earnings than those who do not (Krueger, 1993)—although the direction of causation of this relation is a matter of dispute (DiNardo and Peschke, 1996). It is, in my view, probably too early to determine just how much of the post-1980 technological change is due to computers as opposed to the long-run trend of increased complexity of work environments in general. But we will know more about the answer to this question in 20 years.

[11] An interesting aspect of computer technology is that, compared to many past technological innovations, it has affected virtually every industry in the economy. This point is made by McConnell (1996) in her introduction to a symposium on the labor market implications of computers.

Why Hasn't Technological Change Increased Average Wages?

Over time, the difference between the rate of economic growth and the rate of growth of the quantity of labor input is usually attributed to technological change. It is also roughly equal to the growth of the average real wage rate in the economy, thus providing the link that changes in technology or productivity are closely linked over time to growth in real wages. Since the mid-1970s, however, the average real wage rate in the United States has grown at a very low rate. Returning to the last two columns in Table 2, column *d* shows the slowdown in the growth of real wages that started around the 1970s. By subtracting column *e* from column *d*, it can be seen that the average real wage rate has been essentially stagnant after adjustment for the increase in average wages expected because of the upward shift in the educational distribution. This fact is troubling for any explanation of the rise in income inequality that focuses on skill-biased technological change. After all, if there was so much technological change, why didn't it cause high average real wage increases, rather than the historically unprecedented stagnation of wages?

An answer to this question is that the effect of technological change on the average real wage rate depends on *which kind* of change occurs. Technological change that is neutral with respect to labor skills—that increases the efficiency of both skilled and unskilled labor by the same proportion—will result (after the adjustment of the aggregate capital stock has occurred) in increases in the average real wage equal to the rate at which efficiency increases. A bout of intensive skill-biased technological change—resulting in skilled workers becoming more efficient in jobs that they previously performed—means that as skilled workers become more productive, their wages rise. This also leads to a rise in the wages of unskilled workers, since they are complementary in production. But as long as elasticity of substitution between different types of labor, σ, is greater than one, then employers will not be able fully to substitute unskilled for the higher-wage skilled labor. Since the wages of both types of workers rise, the average real wage rate rises; however, because of imperfect substitutability, the skilled-unskilled relative wage rate will also rise slightly.[12]

However, extensive skill-biased technological change—changes in production processes such that skilled workers are profitably employed in some jobs that unskilled workers used to do—is a different situation. In this case, the wage of skilled workers rises, but the wage of unskilled workers fall. The average wage in the economy rises due to extensive skill-biased technological change, but it does not rise very much, for the increased efficiency associated with skilled workers performing their new jobs more efficiently than unskilled workers used to is at least partially offset by the decrease in employment in the initially skilled jobs and by the lower productivity of unskilled workers in the jobs that remain for them.

A particular innovation, like assembly lines, railroads, or telecommunications,

[12] If $\sigma = 1$, then employers can substitute readily, and the wage premium of skilled labor does not change.

may represent different forms of technological change at different stages of its development. The introduction of personal computers, for example, *may* have increased the efficiency of skilled workers in their initial jobs, but it is clear from the various empirical studies that it caused an increase in the fraction of jobs normally performed by skilled workers. A lot of research and development expenditure over the past 20 years probably went into figuring out ways that various repetitive functions could be computerized. This should have increased the relative demand for skilled labor, but it would not necessarily have increased output per person-hour very much.

Will Inequality Continue to Rise?

The sharp rise in earnings inequality and the virtual stagnation of the average real wage in the United States since the early 1970s are matters of intense public concern. The weight of evidence suggests that the principle cause is an increase in the rate of extensive skill-biased technological change. But will this trend continue? It is possible that as computer technology becomes better able to perform more sophisticated tasks, the effects of technology will change direction so that unskilled workers can become more efficient in jobs that were formerly done by today's skilled workers. For example, insurance agents are reportedly concerned about the implications for their future earnings of the new ability of customers to purchase their policies through the Internet. This would represent the reverse of extensive skill-biased technological change; most of the necessary labor functions with computerized purchases could be performed by high school graduates. If practices of this sort become fairly widespread in the future, the relative demand for skilled labor will not shift to the right as rapidly as it has in the recent past and might theoretically even shift back to the left.

But while one can offer possible examples in particular industries of the technological bias turning in favor of unskilled workers, it would be unwise to stake too much on a movement of this sort reversing the trend toward greater inequality. After all, the demand function for high-skilled labor has been shifting to the right fairly consistently for a long time. Based on the post–World War II experience in the United States, it is highly unlikely that it will not continue to do so. The only realistic question is whether the pace of change will be as great as it has been during the past 25 years.

It is difficult to think of policies that would halt this technological shift—for example, imposing a large tax on computers?—and even if such policies could be put in place, they should not be. Thus, public policies to "do something" about earnings inequality have focused on other proposals, like a large increase in the minimum wage, government training programs, import restrictions, tax rate reductions for rich old people, and so forth. While this paper is not the place for a review of these choices, it is fair to say that most of the available options either present potentially undesirable side effects or may work only very slowly or not at all, or all of the above.

Will the supply side of the economy adjust to reduce the amount of inequality? There has been a fairly steady rightward shift in the educational distribution in the United States over the past half century. The trends shown in Table 1 imply that the relative supply of college/high school equivalent labor has grown at an average annual rate of 2.9 percent. Further, one might suppose that the huge increase in the private rate of return to investment in a college education associated with the rise in the college/high school relative wage would cause a large increase in the relative supply of college graduates, which could eventually reduce the wage premium of high-skilled labor.[13] This is the story implicit in Figure 1, in which the vertical short- run relative supply function shifts over time the same amount as the relative demand function so that, in the long run, R returns to R^*. If this story were correct, the rise in inequality would be a relatively temporary event—that is, lasting perhaps another decade or two—that might not require policy intervention.

There is some supply adjustment in the pipeline, judging from the time series data on the educational attainment of young adults and of the proportion of college-age persons enrolled in school. For example, the proportion of 20- to 21-year-old males enrolled in school rose from 31.6 percent in 1979 to 42.6 percent in 1993, while the value of R increased by 17.7 percent. The implied relative supply elasticity is 1.7, which is in line with previous estimates of this parameter (Freeman, 1986). This value, however, is not nearly large enough to yield the 3 to 5 percent rates of growth of relative supply—depending on whether the next 15 years is like the 1950-1980 or the post-1980 period—necessary to keep up with the likely technologically induced shifts in future demand for high-skilled labor.

In addition, much of the past high rates of increase in the relative supply of educated labor was due to the replacement of old people with a low average level of schooling by young persons with a high average level. Beginning around 2010, the average level of education of labor force exiters will be quite high, reflecting in part the large boost in the number of students who attended college in the 1960s, probably in part because it was a way to defer military service. For the relative supply of educated labor to grow rapidly after 2010, rates of college attendance will have to be extremely large to avoid a new bout of wage inequality.

[13] The rate of return to a four-year college program is that discount rate that equates the present value of the streams of net earnings associated with attending versus not attending college. Its approximate value is

$$r_c = \frac{1}{4}\frac{W_c - W_h}{W_h + C} = \frac{1}{4}\frac{R - 1}{1 + C/W_h},$$

where W_c and W_h are the annual wages associated with the college and high school options, $R = W_c/W_h$, and C is the annual private cost of college. An infinitely elastic long-run relative supply function would require that, over the relevant range, all potential college attenders are uniform with respect to ability and tastes and face a perfect capital market. If these conditions are not met, the long-run supply of college graduates would have a finite positive elasticity.

It would seem, therefore, that a long-term commitment to increasing greatly the fraction of individuals who go to college is the appropriate public policy response to the phenomenon of increasing inequality. But this is more easily written than done effectively.

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