SKILL-BIASED DEMAND SHIFTS AND THE WAGE COLLAPSE IN THE UNITED STATES: A CRITICAL PERSPECTIVE

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Since the late 1970s the U.S. labor market has featured both sharply declining real wages for low-skilled workers and declining shares of middle income jobs [Levy and Murnane, 1992]. These two developments have had a devastating effect on many families and communities and contributed to unprecedented increases in earnings inequality. Attempting to address these labor market problems, both federal and state policy makers have assigned top priority to the development of programs that enhance worker skills. This human-capital solution is consistent with the widespread view among economists that the growth of earnings differentials by education level in the 1980s can be explained by a major shift in demand away from low-skilled workers caused by skill-biased technological change. In the words of former Secretary of Labor Robert Reich, the widening disparity in economic well-being between more- and less-educated workers is the result of "technological changes [that] have diminished the role of labor, especially unskilled labor, in the modern factory.... The most striking change has been the brash arrival of the computer" [1993]. This mirrors the accepted wisdom among mainstream labor economists [Freeman and Katz, 1994; Bound and Johnson, 1995; Johnson, 1997].

At first glance, the data appear to be consistent with this technology-induced skill mismatch story. The intensity of computer-related investments grew sharply in both manufacturing and service industries in the 1980s, rising in 1987 dollars from about $150 per full-time equivalent worker in 1982 to about $1,000 per worker ten years later.[1] Table 1 shows that during that same time, the real hourly earnings of male workers with less than a high-school degree fell by almost 17.4 percent. This compares with just a 2.3 percent decline between 1973 and 1979. The wage collapse for these workers continued into the early 1990s, dropping by almost 10 percent between 1989 and 1993. Indeed, even those with post-graduate education (18+ years) show declines in the early 1990s. In sharp contrast, among female workers, only those with less than a high-school degree experienced substantial real wage declines between 1979 and 1993.

TABLE 1
Changes in Real Wages By Education and Gender 1973-93

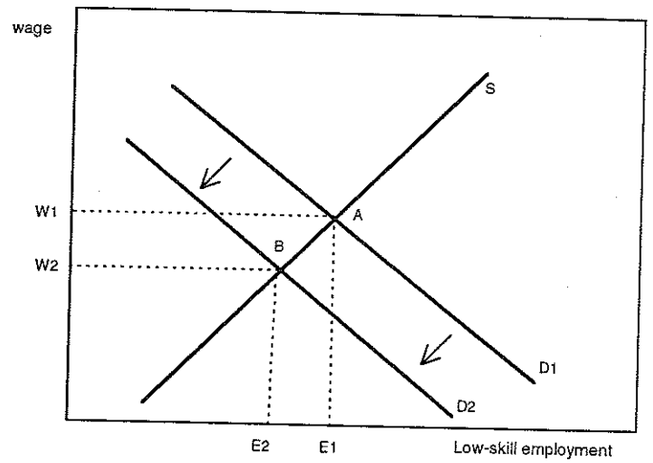
Years of Schooling	1973-79	1979-89	1989-93
	Men		
0-11 years	-2.3	-17.4	-9.7
12	-3.8	-12.3	-5.4
13-15	-2.9	-6.2	-5.3
16	-6.7	0.3	-2.9
18+	-8.5	9.8	-2.6
	Women		
0-11 years	3.9	-10.7	-1.2
12	0.2	-2.9	0.2
13-15	-2.3	5.7	-0.3
16	-11.6	12.5	2.3
18+	-11.6	13.7	1.4

Source: Mishel & Bernstein [1994], Tables 3.19 and 3.20.

According to the skill mismatch story, the growing use of computers in the workplace appears as a demand shock, sharply increasing the demand for skills within firms and industries and reducing the value of low-skilled workers in the marketplace. The predicted effects on wages and employment can be demonstrated with the conventional labor market model shown in Figure 1. In the simple case of a downward shift in demand for low-skilled workers, the equilibrium shifts from point A to point B and both wages and employment decline. It might be argued that we should also show a leftward shift in the supply curve, since the share of workers with a high-school degree or less fell from 22.4 percent in 1979 to 15.9 percent in 1989, and test scores for white, black and Hispanic 17-year-olds all increased substantially over this period [Mishel and Bernstein, 1994b, Tables 3.19 and 3.25]. With a declining pool of low-skilled workers, the conventional model would predict an even larger fall in low-skill employment and a smaller decline (or even an increase) in low-skill wages.

Finally, according to this view the reverse is true for highly-skilled workers: an upward shift in demand leads to rising wages and employment. Under these circumstances, the wages and numbers of highly-skilled workers should increase substantially relative to low-skilled workers. Thus, the assumption of large technology-driven demand shifts in the simple textbook model suggests that we should observe both relative wage declines and sharply falling shares of employment for lesser-skilled workers. Like many others, Paul Krugman [1994] asserts this as a 'stylized fact' of the recent period: "There has been an across the board increase in the ratio of skilled to unskilled workers employed within each industry, in spite of the rise in relative wages of the skilled."

FIGURE 1
The Conventional View: Declining Demand Generates Declining Wages and Employment among the Least Skilled



The conventional view, then, is that the evidence of rising skill intensity coincident with rising relative wages of the skilled makes a *prima facie* case that skill-biased demand shifts are at the root of the wage problem [Gottschalk and Smeeding, 1997]. This paper suggests that there are considerable grounds for skepticism regarding the increasing skill intensity part of the story. Our assessment of this conventional wisdom is presented in four parts. First, the research literature offers quite mixed evidence on the correspondence between technological advances in the workplace, changes in either skill intensity, and relative wages by skill group. We briefly survey some of the recent literature on these questions in the next section.

Second, empirical evidence on changes in the skill mix of employment at the national and industry levels appears to provide little support for the skill-biased demand shift story. We should observe large, persistent, and even accelerating shifts in employment away from lower-skill occupations toward those requiring higher cognitive skills throughout the 1980s. The standard measures of skill intensity, however, have shown remarkable stability since the 1980-82 recessions. Critically, the timing of this period of stability coincides with the rapid expansion of use of computers in the workplace. Indeed, if anything, skill intensity shows a slower rate of growth after 1982 than in previous decades.

Third, as Figure 1 shows, the skill-biased demand shift explanation predicts that employment changes should be positively associated with wage changes. It is the widespread belief that skill intensity has risen and has coincided with rising relative wages of the most skilled. That confirms, in the conventional view, that a demand

shift must be an important part of the story. Our results for five computer-intensive industries provide no support for this prediction.

This lack of compelling empirical evidence suggests that the widespread acceptance of the skill-biased demand shift explanation may stem from an exaggeration of the skill enhancing impacts of computers. It may also reflect a tendency to demand too much from the simple supply-and-demand model, one that effectively rules out a significant political and social dimension from the wage-setting process. To put it differently, there is a *prima facie* case for the demand shift story only because the underlying conventional neoclassical vision does not encompass a serious role for changes in labor market institutions, public policies, management strategies, and social norms in wage determination. But as David Gordon [1996] has put it, there is an alternative "low-road hypothesis," which is that "a critically important source of falling wages has been U.S. corporations' increasingly aggressive stance with their employees, their mounting power to gain the upper hand in those struggles, and the shifts in the institutional environment that this mounting power has helped foster." We sketch this heterodox account of the wage collapse and conclude this paper in the final two sections.

TECHNOLOGY, SKILLS AND EARNINGS

With the rapid diffusion of computer-based technologies since the early 1980s, it is widely believed that the old regime of large, integrated, capital-intensive plants relying on low-skill manual labor is being transformed into a new production system of small, flexible, technologically advanced firms that depend upon an elite cadre of highly-educated workers. Unlike the traditional "Taylorist" model, in the new "high-performance" workplace workers must possess the cognitive and diagnostic skills necessary to perform a broad range of frequently changing tasks. In this new regime, computers and related technologies require higher skills; workers with obsolete or insufficient skills get paid less and ultimately lose their jobs, leaving behind a more skilled workforce. This transformation is undoubtedly underway in some "best practice" firms. Of course, to explain the massive wage restructuring that has occurred, this phenomenon would have to cover many, if not most, low-skill jobs — those in retail trade and business services as well as in durable manufacturing and construction.

Recently, this vision of the 1980s workplace as radically reshaped by new flexible technologies requiring highly-skilled workers has been challenged. Harrison [1994] has convincingly argued that small firms tend to be the *least* technologically advanced and tend to employ workers at the *lowest* wages. Indeed, recent research has consistently shown that high performance workplaces are most likely to appear in the largest establishments. But even among large establishments, organizational changes in the workplace have been gradual. For example, a 1993 Labor Department survey gathered information at the establishment level on the presence of six possible "alternative work practices" that are commonly cited as the hallmarks of high-performance workplaces. Evidence of even two of these practices appeared in only about 20 percent of establishments with more than 50 employees. Only 6 percent of these moderate-to-large establishments report as many as four alternative practices [Gittleman, Horrigan, and Joyce et al., 1995]. These figures suggest that by the early 1990s only a very small share of establishments had been transformed into high-performance, and presumably high-skill, workplaces.

Evidence also challenges the assumed strong correlation between cognitive skill requirements and the use of new technologies and/or alternative work practices. Indeed, the case study evidence suggests that new information technologies can *reduce* skill requirements. Summarizing the McKinsey Global Institute's "Manufacturing Productivity" study, Simon Head [1996] writes, "McKinsey also found that when Japanese corporations achieved higher rates of productivity, their need for skilled labor declined, particularly on the shop floor." In his study of machine shops in the United States, Jeffrey Keefe found that "the diffusion of NC (numerical controls) has had no significant impact on overall machine shop skill levels" [1991, 515-16]. Using data from a large compensation consulting firm, Peter Cappelli reports significant skill upgrading for most production occupations between 1978 and 1986, but consistent with Keefe's finding, the cause did not appear to be technological change: "Changes in production jobs seem much more driven by developments in traditional employee relations arenas. Particularly influential have been new management views concerning how jobs should be redesigned" [1993, 528]. Among clerical jobs, Cappelli [*ibid.*, 524] finds that half "experienced significant upskilling, and the other half had significant deskilling" and concludes that new office technologies appear to be the cause of the deskilling.

In an effort to study the determinants of the levels and change in skill requirements since 1970, Howell and Wolff [1992] measured the use of new technology by the value of computer purchases per dollar of output, the share of new investment in total capital stock, and the share of engineers in the total workforce. Skills were measured by indices of cognitive, interactive, and motor skill job requirements derived from the Dictionary of Occupational Titles as well as by the shares of five large occupational groups in total employment. While a more intensive use of new production technologies was associated with an increase in the cognitive skill levels of the workforce, the use of occupation shares as measures of skill levels produced mixed results: increases in the technology measures were associated with higher shares of professional and technical workers (high cognitive skill), but lower shares of managers (moderate-high skill), clerical workers (low-moderate skill), and operatives and laborers (low skill).

In perhaps the most influential study in this literature, Berman, Bound and Griliches point to the large increase in the nonproduction share of manufacturing employment in the 1980s: "Between 1979 and 1989 the employment of production workers in U.S. manufacturing dropped by a dramatic 15 percent from 14.5 to 12.3 million, while non-production employment rose 3 percent from 6.5 to 6.7 million" [1994]. The authors interpret these trends as evidence that the manufacturing sector experienced substantial skill upgrading over this decade and that "biased technological change is an important part of the explanation" [1994, 33].[2] But as we will argue below, observed movements in the nonproduction (or supervisory) share of employ-

ment do not appear to strongly supported the view that skill-intensity has risen steadily and substantially since the early 1980s as a result of workplace computerization.

While in a cross-section of firms, those with the most advanced technology tend to employ more highly-educated workers, the link between the investment in high tech equipment and the *change* in skill requirements is weak. Doms, Dunne and Troske, for example, conclude that "our time-series results show little correlation between changes in the plant-level skill mix of workers and technology adoption. Plants which adopt a large number of new technologies do not appear to shift toward the use of more skilled workers relative to plants which adopt a small number of new technologies" [1995].

From the vantage point of the entire economy, no doubt the demand for highly skilled workers has increased considerably. As Fritz Machlup pointed out back in the early 1960s, the increase in the demand for information workers — those with relatively high cognitive skills — dates to at least the turn of the century. While this was caused in large part by the strong shift away from agriculture in the early decades of the century, the same trend can be found in the goods industries since the 1940s. Indeed, the share of semi-skilled and low-skilled manual workers in total employment declined substantially in each decade from 1950 to 1980 [Howell and Wolff, 1993]. But challenging the skill mismatch premise that information technologies have accelerated the shift in the skill mix away from low-skilled workers, several recent studies using economy-wide data on occupation and industry employment trends and direct measures of skill requirements have found *declining* rates of skill growth with each decade since the 1960s [Howell and Wolff, 1991; Mishel and Teixeira, 1991].

Like the link between technological change and skill mix, the evidence on the relationship between the use of new technology and earnings is mixed. Most recent research on the effects of technological change on earnings using aggregate data have employed indirect measures of technological change (productivity growth or the residual from wage equations) and skills (educational attainment, potential experience, or relative wages). These studies offer some evidence that both educational attainment and the return to education are higher in industries that are more technology-intensive, usually measured by R&D spending (or employment) and total factor productivity growth [Bartel and Lichtenberg, 1987; Mincer, 1991; Allen, 1993]. But as with the association between technology and skill requirements, there is less evidence that becoming relatively more technologically advanced accounts for the rise in relative wages at the firm or industry level.

In a celebrated finding, Krueger [1993] found that individuals who use computers gain a 10-15 percent wage advantage. Krueger's interpretation of his results has been strongly challenged by at least two recent studies. DiNardo and Pischke [1997] test this relationship with German data and find "similar wage differentials for the use of pencils at work as for computers." Their results suggest that the payoff to computer use does not reflect, as they put it, "an actual productivity differential." In another study using U.S. data, Michael Handel finds that Krueger's measured returns to computer use are strongly biased upward, and concludes that "When the contribution of computer use to all components of the variance of wages are taken into account, computers seem to have had a net equalizing impact in the period Krueger studied. This casts significant doubt on this technology-based explanation of the growth of wage inequality" [1997, 2]. Even if there are substantial returns to computer use, there is no evidence that a failure to use computers at work explains the earnings declines for blue-collar occupations such as truck drivers and construction laborers. Nor does this explanation appear to help account for sharp wage declines experienced by cashiers and sales clerks, who are among the most intensive users of computer-based information systems.

Allen [1993], on the other hand, presents evidence that the rate of technological change, as measured by the share of R&D scientists and engineers in total employment, was greater in the 1980s than in the 1970s and concludes that some of the wage restructuring during this decade can be attributed to this increase. His measure of technological change accounts for 48 percent of the increase in returns to schooling in the 1980s for workers in manufacturing, but only 7 percent for the entire workforce. These results imply that trends in manufacturing cannot be generalized to the entire economy. But even within the manufacturing sector, Allen points out that his results do not suggest that technological change alone can explain much of the sharp absolute declines in the real earnings of low-skill male workers in the 1980s. As he puts it, "Rising R&D activity is associated with higher wages for college graduates, but is completely unrelated to wages of other educational groups. This implies that the correlation between R&D and returns to schooling...reflects greater wage growth for college graduates in R&D-intensive industries, rather than a negative demand shock for high school graduates employed in those industries" [*ibid.*] This is significant since most of the growth in wage inequality between highly- and poorly-educated workers in the United States has been driven by the wage collapse among the latter [Gottschalk, 1997].

Mishel and Bernstein's [1994a] results are even less supportive of the skill-biased technological change explanation for growing wage inequality. Measuring technology by investment in computers and by the share of scientists and engineers in employment, they find that technology had no greater, and perhaps a lesser, effect on wage inequality in the 1980s than in the 1970s. In fact, they find that increased investment in computers contributes to wage equalization in the bottom half of the distribution.[3]

OCCUPATIONAL EMPLOYMENT PATTERNS IN THE 1980s

It seems safe to say that computer-based technologies did not have substantial effects on the organization and performance of most workplaces until the mid-1980s. Berman, Bound and Griliches [1994] report a rapid increase in the rate of growth in the real value of computer investments as a share of total investment in manufacturing: from 2.79 percent in 1977 to 3.92 percent in 1982 and 7.49 percent in 1987. Extending this time series, Oliner and Wascher's [1995] calculations show a growth of this measure of computerization from 8.7 percent in 1990 to 20 percent in 1994.[4]

The conventional technological change explanation for skill restructuring implies that the decline in the share of low-skill jobs should follow this pattern. That is, since the diffusion and effective use of computer-based technologies increased sharply in the early- to mid-1980s, it would be reasonable to expect shifts in the skill mix of employment to at least persist and perhaps accelerate over the course of the following decade. Reflecting this view, Richard Freeman and Lawrence Katz write that "In the 1980s, the increased use of microcomputers and computer-based technologies shifted demand toward more educated workers.... Whether because of computerization or other causes, the pace of relative demand shifts favoring more skilled workers *accelerated* within sectors" [1994, emphasis added].[5]

Among the most cited references for evidence of these skill shifts is the study by Berman, Bound and Griliches [1994]. They present evidence of a large shift from production to nonproduction employment in manufacturing between 1979 and the late 1980s. But a close look at their employment data shows that virtually all of this "skill upgrading" took place in just 3 years — 1980, 1981 and 1982. Indeed, their data indicate that the nonproduction share of employment in 1983 was identical to the share six years later, which does not support the acceleration hypothesis. Indeed, using the same measure of "skill," Figure 2 suggests a more ambiguous story. We plot the nonproduction employment shares for durable, nondurable and total manufacturing for 1963-96. The trends clearly show that skill shifts in manufacturing — as measured by the nonproduction employment share — can be traced primarily to durable manufacturing between 1980-82. The share of nonproduction workers in this sector increased sharply, from 28.6 percent in 1979 to 33.8 percent in 1982, fluctuated between 33 and 34 percent over the next decade, and then dropped to 31.5 percent in 1996. The nonproduction share in nondurable manufacturing has shown small fluctuations around 30 percent for the entire 1982-96 period.

While the economics literature has focused on manufacturing, the service sectors account for a far larger share of total employment. Figure 3 plots the supervisory share of employment in 4 large service industry groups. In 1996, manufacturing employed about 18.2 million workers. This compares to 27.3 million in Wholesale and Retail Trade, 6.2 million in Transportation and Public Utilities, 6.9 million in Finance, Insurance and Real Estate, and 33.5 million in Miscellaneous (business, professional, and personal) Services [U.S. Department of Labor, 1996].

Figure 3 shows that while the supervisory share of employment in these four service groups increased markedly in the 1970s, it remained remarkably stable over the 1983-96 period. The only exception is the Finance, Insurance and Real Estate Sector, in which the supervisory share continued to increase through the mid-1980s. But from 1988 through 1996 the skilled worker share in this sector remained unchanged at just over 27 percent. This measure of skill mix actually shows a sizable decline in the Transportation and Public Utilities sector, from 17.8 percent in 1983 to 16 percent in 1996. The two largest service groups, Trade and Miscellaneous Services, experienced modest increases in supervisory share in the 1980s and no change from 1991-96.

FIGURE 2
The Nonproduction Share of Manufacturing Employment, 1963-96

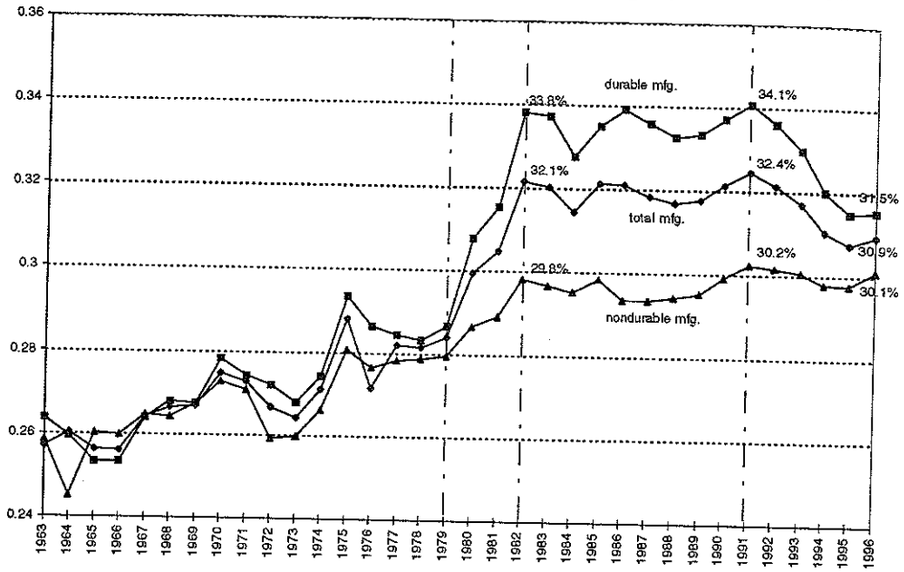
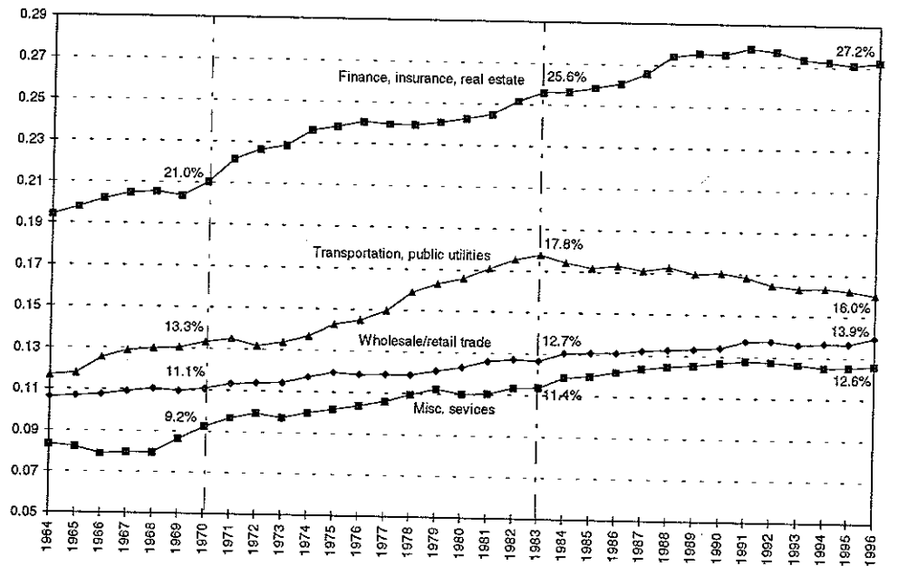


FIGURE 3
The Supervisory Share of Employment in Large Service Industry Groups, 1964-96



To provide a more detailed portrait of shifts in skill composition, we have extended the approach taken by Berman, Bound, and Griliches [1994] by distinguishing skilled from unskilled occupations separately for white-collar and blue-collar occupations in five large relatively computer-intensive industry groups. Skilled white-collar workers are defined as those employed in managerial, professional and technical occupations; low-skilled white-collar workers are those employed in administrative support occupations; skilled blue-collar jobs include mechanics and repairers, construction and extractive trades, and precision production occupations; and low-skilled blue-collar jobs refer to operators and assemblers, transportation and material moving occupations, laborers and guards. As in the Berman, Bound, and Griliches study, these skill measures refer to the occupational mix of each industry. Although skill upgrading may be taking place within occupations, a strong trend away from low-skill occupations should be observed throughout the decade if the skill mismatch story is right.

We examined two large manufacturing industry groups, Machinery/Instruments (SIC 35, 36, 38) and Transportation Equipment (SIC 37). The Machinery industry group was not only much more computer-intensive than Transportation Equipment but experienced far greater absolute growth in computer-intensity. While the former increased its investment from $389 per full-time equivalent worker in 1983 to almost $1,900 in 1992, spending by the Transportation Equipment industry rose from $112 to $744 per worker. These investment patterns suggest that we should see substantial and persistent employment shifts away from low-skilled occupations over the course of this period, particularly in the machinery group.

Figure 4 shows a large employment shift in the machinery industries away from low-skill blue-collar employment between 1979 and 1985, from about a 38 percent share to just 25 percent. But during the mid- and late-1980s this share reversed direction and rose to 28.4 percent. In fact, the 1983 and 1990 low-skill blue-collar shares were almost identical. Neither high-skill white-collar nor high-skill blue-collar shares show much change between 1983 and 1990.

Similarly, Figure 5 shows that the Transportation Equipment industry experienced a dramatic fall in the share of low-skill blue-collar workers, from 42 to about 28 percent of the workforce between 1978 to 1981. But from 1983 to 1990, there is little observable trend; the low-skill blue-collar share fluctuates around 35 percent. Similarly, the high-skill blue-collar share in Transportation Equipment stays around 25 percent from 1983 to 1990.

In contrast to this low-skill blue-collar stability after 1982, both manufacturing industry groups show declining low-skill white-collar shares. In the Machinery industry, administrative support jobs declined from 13.5 percent of employment in 1986 to 11.8 percent in 1990. In Transportation Equipment, the same jobs declined from 10.2 percent in 1986 to 8.7 percent in 1990. These trends suggest that the main effect of computer-related skill restructuring across occupations was a shift away from administrative support jobs toward professional, managerial and technical jobs at the end of the 1980s.

FIGURE 4
Occupation Shares in Machinery (SIC 35, 36, 38), 1978-90

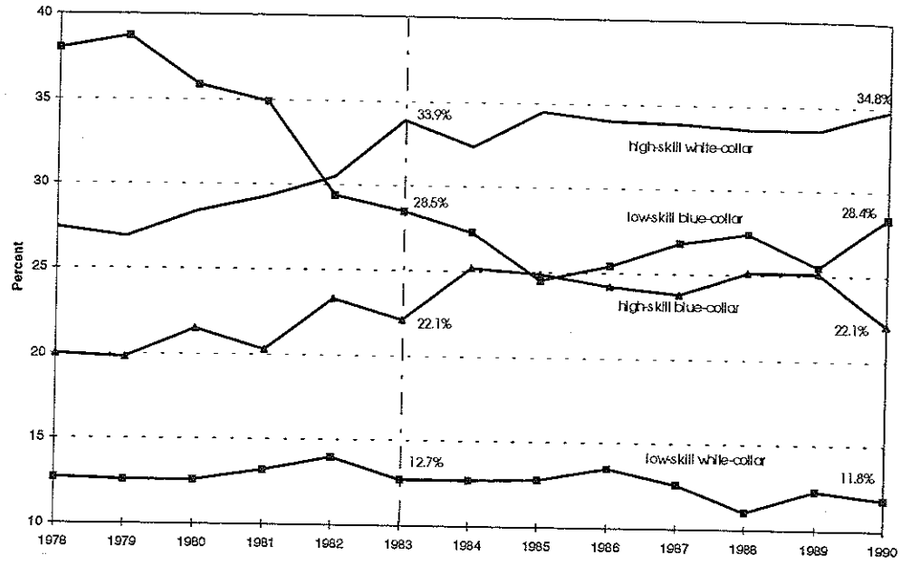


FIGURE 5
Occupation Shares in Transportation Eqt (SIC 37) 1978-90

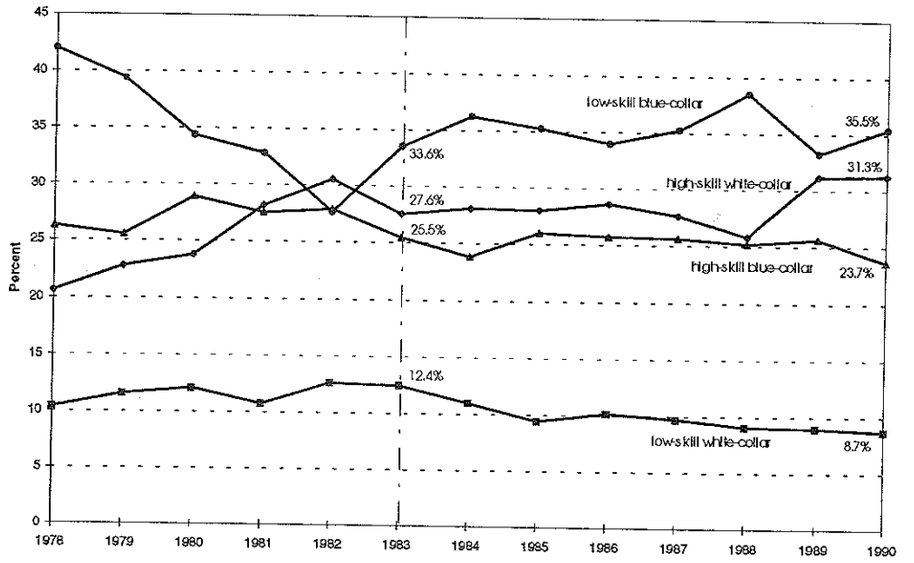


FIGURE 6
Occupation Shares in Wholesale and Retail Trade (SIC 50-69), 1978-90

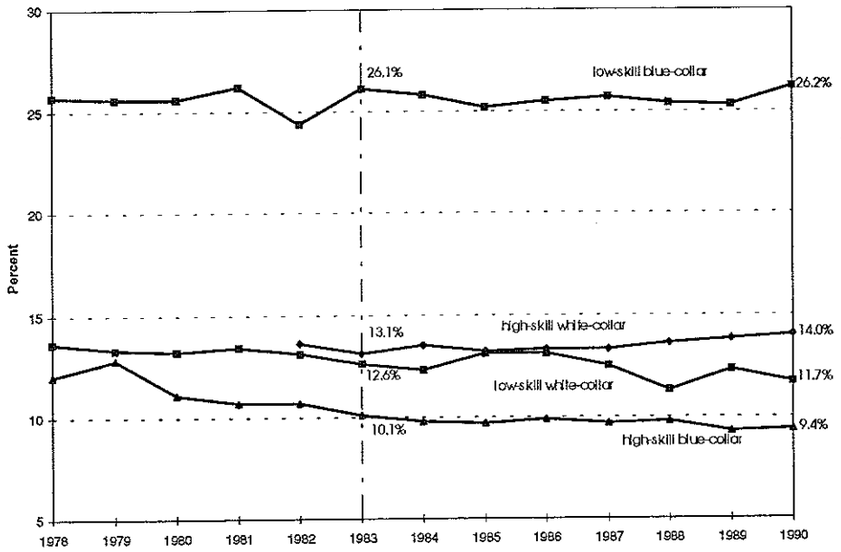
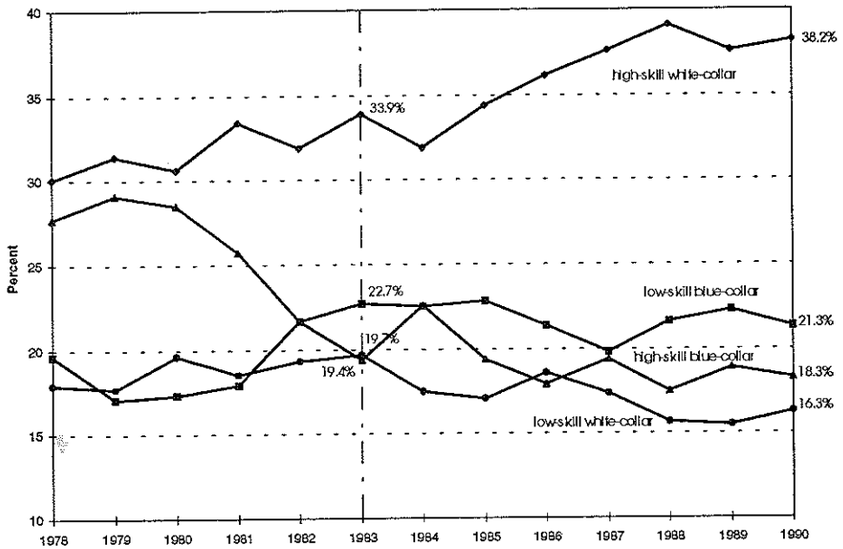


FIGURE 7
Occupation Shares in Business and Repair Services (SIC 73, 75-76), 1978-90



The skill composition of service industries shows similar patterns. All three industry groups show large increases in computer investment per worker after 1982, with by far the greatest intensity and growth in the finance industries, where computer investment increased from just under $460 per full-time equivalent worker in 1982 to over $4,600 in 1992 (1987 dollars). The Trade industries increased their spending on computers and related equipment from under $100 in 1982 to $642 in 1992, while investments by Business and Repair Services rose from $271 in 1982 to $958 per worker in 1990.

Like the two manufacturing industry groups, the low-skill blue-collar employment shares in these service sectors do not show the decline predicted by the skill-biased technological change story. While the Trade sectors show no change in the share of these workers, the Business and Repair Services sector actually reported a substantial increase, from 17 percent in 1979 to 22.7 percent in 1983. This figure then held steady in the 20 to 22 percent range from 1983-90. Like their manufacturing counterparts, all three service industries show some skill upgrading in white-collar employment between 1983 and 1990. Consistent with the timing of investments in computers, the Trade and Business Services sectors (Figures 6 and 7) show steady declines in low-skill white-collar employment shares between 1986 and 1990: from 10 to 9.4 percent and from 18.6 to 16.3 percent respectively. Similarly, the low-skill white-collar share in the Insurance and Banking sectors (not shown) fell steadily from 50.4 to 47.2 percent between 1986 and 1990.

In sum, these employment trends offer little support for the skill-biased technological change story — after 1983 we observe almost no change in the occupational mix of employment through the early 1990s. The only employment shift among low-skilled workers whose nature and timing appear consistent with the computerization trends is the decline in administrative support (predominantly female) shares in the last half of the decade.

SKILL SHIFTS AND WAGE TRENDS IN FIVE INDUSTRY GROUPS

Viewing the labor market through the lens of the standard labor market model, evidence of declining earnings at the bottom and rising earnings at the top must indicate, in the absence of substantial shifts in supply, large and persistent shifts in the demand for skills. Much of the recent research on earnings has been framed and interpreted within this simple competitive model.[6] Evidence of upward shifts in the demand for skills may reflect either an increasing concentration of workers in high-skill jobs or the increasing skill requirements of particular groups of jobs. A shift in demand towards highly-skilled workers should increase both their relative wages and employment shares. That is, wage and employment changes across occupation-industry groups should be positively correlated. A second prediction is that, if increasing skill content of individual jobs underlies observed shifts in relative wages, rates of growth in educational attainment — a measure of skill content — should be positively associated with rates of wage growth. Although educational attainment is not an ideal measure of skill requirements, it seems reasonable to suppose that skill

requirements for many jobs have increased substantially, and it is this increase that accounts for most of the collapse in wages for low-skill workers (in low-skill jobs), then the relative change in educational attainment across occupation/industry groups should reflect these higher demands for skills and contribute to the explanation of recent wage trends.

To explore the empirical support for these predictions, we regressed changes in earnings on changes in the occupation share of employment (shifts in the skill mix of employment) and on the growth of educational attainment (shifts in the skill content of jobs) for our occupation-industry groups: high- and low-skill white- and blue-collar jobs in five large, relatively computer-intensive industries.[7] Since we know that the real earnings growth of workers in the 1980s varied dramatically by level of schooling, we also include educational attainment in the initial year as a control.[8] Table 3 presents the results. The first column covers the full period for which we had data (1978-90) and excludes 3 occupation-industry cells due to inadequate numbers of workers (high-skill and low-skill blue-collar groups in the Finance sector) and difficulties imposed by the Census Bureau's shift to a new occupation classification system (high-skill white-collar workers in Trade). To test for the period in which computerization took off and to avoid the effects of the structural changes prior to 1983 and the possible recessionary effects of 1990, a second test covers the 1984-89 period. For each occupation-industry cell, the dependent variable is the rate of change in the log of annual wage and salary earnings for full-time full-year workers, *doccshr* is the rate of change in the employment share, *deducn* is the rate of change in the average educational attainment, and *educn* is average educational attainment in the initial year.

As expected, the coefficients in Table 2 show that real wage growth was strongly associated with the level of educational attainment in the initial year. But we found no effect of *changes* in educational attainment on relative wage growth. An examination of the schooling trends suggests that the explanation for this lack of association is that educational attainment gradually increased across-the-board for all of the skill groups. Most importantly, we find *negative* effects of changes in occupation employment shares. This result directly conflicts with the predictions of the skill shift story: shifts in labor demand, assuming a conventional demand and supply world, should be *positively* related to wage changes.

These results must be confirmed by tests on a far more detailed and comprehensive set of occupation-industry groups. But for purposes of interpretation, this small set of observations has advantages. Plotting our 18 industry-occupation groups by wage growth and the change in employment shares for 1978-90 (not shown) suggests two problems for the standard demand shift explanation. First, the change in employment shares is not closely associated with the level of cognitive skill requirements. While high-skill white-collar workers in each of the industries had relatively high rates of growth in employment shares, so did low-skill blue-collar workers in Business Services and high-skill blue-collar workers in Machinery. And these two blue-collar groups had higher employment growth rates than low-skill white-collar (administrative support) workers in all five industries, despite lower educational attainment levels and much lower rates of computer use at work [Holzer, 1995].

TABLE 2
Regression Results for
Occupation-Industry Wage Change in the 1980s
(T-Statistics in Parentheses)

	1978-90	1984-89
doccshr	-.207 (-2.27)	-.036 (-.36)
deducn	.217 (.15)	.889 (.90)
educn	.005 (3.54)	.004 (2.87)
R^2	.508	.404
N	17	18

Second, there is no obvious link between changes in employment shares and changes in wages. The occupation-industry groups that show positive wage growth were in most cases white-collar occupations (craft workers in Transportation Equipment is the one exception), but two high-skill white-collar groups show slight declines in wages (in Transportation Equipment and in Business Services). Indeed, of the four groups that show similar slight declines in earnings, two experienced declining employment shares (low-skill blue-collar workers in Machinery and Transportation Equipment) and two show strong employment growth (high-skill white-collar workers in Transportation Equipment and Business Services). For all five low-skill white-collar groups, real wage change was positive but employment shares declined.

While these results indicate that wage growth was greater in the white-collar job groups than in the blue-collar groups, they also indicate that shifts in skill requirements, whether measured by changes in educational attainment or by changes in the employment shares of high- and low-skill occupations, are not systematically linked to the wage changes experienced by workers in these industry groups in the 1980s.

Recent case studies on the transformation of U.S. workplaces in the 1980s by industrial relations specialists appear consistent with this interpretation of the evidence. This research has focused, not on changes in the skill mix of employment following the introduction of new information technologies into the workplace, but on radical shifts in the norms and institutions governing the employment relation: widespread employer demands for wage and benefits concessions, aggressive anti-union campaigns, and the use of outsourcing, relocation, and temporary workers to lower wage costs [Voos, 1994; Kochan, Katz and Mckersie, 1994; Appelbaum and Batt, 1994)]. Much like the near universal belief among economists, at least until recently, that the minimum wage has significant negative employment effects [Card and Krueger, 1995], the dominance of the simple textbook model of the labor market rather than empirical evidence may explain the success of the skill-shift explanation. The next section offers a tentative outline of an alternative story.[9]

The Alternative: A "Low-Road" Story of the Wage Collapse

> The 'low-road hypothesis'... illuminates the sources of the wage squeeze much better than the consensus views. It proposes that since the early to mid-1970s, deepening and extending their reliance on the Stick Strategy, more and more U.S corporations have taken the "low road" to economic growth and profitability, seeking to compete by lowering labor costs... (promoting) fundamental institutional changes in both labor relations and the broader political environment that affects the interaction between corporations and workers" [Gordon, 1996].

Our heterodox story begins with the premise that the simple neoclassical model may not accurately describe the essential features of the labor market for low-skilled workers. Supply and demand matter, of course, but institutions and social norms are increasingly recognized as central to the wage-setting process. This recognition was central to the work of an earlier generation of "neo-institutionalist" economists in the early post-war period — a group that includes Dunlop, Slichter, Reynolds, Kerr, and Lester.[10] A basic premise of this school of thought was that within a certain range, employers choose high or low starting wages and a particular wage-tenure profile for strategic reasons. That is, most employers are not strictly price-takers in the labor market.[11]

There are a variety of reasons to expect that bargaining within a *wage-setting space* in which specific outcomes are indeterminate better captures the reality of wage determination in low-skill labor markets than the textbook vision of a set of equilibrium wage-employment points determined by the interaction of supply and demand, illustrated by Figure 1. Neither firms nor workers may actually know a worker's marginal revenue product since this is commonly a *team* or *social* outcome [Thurow, 1975]. It is also increasingly recognized that both wages and worker effort are, in important respects, bargaining outcomes reflecting norms of fairness and reciprocity [Akerlof and Yellen, 1986; Bewley, 1995]. Firms, establishments, job groups and locations differ in many ways that are relevant for wage setting. These include, for example, 1) the information that employers have about worker performance (requiring hiring and monitoring costs), 2) the idiosyncratic skills and firm-specific training of workers, 3) employer power in the product market, 4) the labor share of costs (the incentive firms have to increase competitiveness by targeting wage costs), 5) the ability of workers to act collectively, 6) the social norms in the community, and 7) long-run competitive strategy of management. Given these differences in the conditions in which wages are actually set, *substantial differences in wages and wage growth can be predicted across job groups, establishments and industries for observationally equivalent individuals.*

Dan Luria [1996] has recently reported evidence supporting this perspective. With proprietary data for the manufacturing plants of 3,000 firms with fewer than 500 employees for the early 1990s, Luria finds huge differences in management strategy and plant performance, with substantial consequences for wages and skill requirements. He states, for example, that "Metal-formers making the same products for the same customers have value added per employee anywhere between $40,000 and $140,000. Indeed, in every industry the productivity level of the most productive 10 percent of shops is at least 160 percent of the industry median ... the huge dispersion in performance applies to nearly every metric the database supports, from on-time delivery to scrap rate to inventory turnover" [*ibid.*]

If labor market institutions play key roles in wage-setting, what changed in the 1980s? In the earlier "golden age" of wage determination for low-skilled workers, wage-setting norms for "good" nonsupervisory ("subordinate primary") jobs limited the tendency of labor market competition to bid the wages of unskilled workers down to subsistence levels. Cappelli provides a concise description of these employment arrangements. Internalized employment systems, he writes,

> helped insulate employment from the pressures of competitive product and labor markets. They served to ensure an adequate flow of skills throughout the organization, especially firm-specific skills. They created incentives for adequate performance and employee attachment. And they created a kind of exchange-based psychological contract — employee loyalty and adequate performance in return for security and predictable improvements — that maintained employee attitudes like commitment" [1993]

Two pivotal developments simultaneously undermined this postwar employment system. First, the United States underwent a sharp swing in national values, or ideology, shifting away from collective and public solutions towards private, market solutions, just as it had in the 1920s and 1950s [Hirschman, 1982; Schlesinger, 1986; Phillips, 1990]. This ideological shift was reflected in numerous pro-market public policies that affected labor markets in the Carter administration, from deregulation to macro policy [Phillips, 1990]. An example of this shift in public policy can be seen in the decision by President Reagan to replace striking federal air traffic controllers strikers in 1981, an anti-union strategy rarely employed prior to this time, even by private sector employers in the midst of the most hostile labor-management confrontations (see below).

Minimum wage policy offers another example of the effects of shifts in ideological climate on government support of key labor market institutions. In this new market-oriented political climate, legislators failed to approve increases in the legal minimum wage, allowing its real value to decline by some 27 percent between 1979 and 1988, a collapse that had a significant impact on the low-skill labor market.[12] The declining value of the minimum wage occurred simultaneously with increasingly severe crowding in the secondary labor market, caused at least in part by federal policies that produced near record levels of legal and illegal low-skill immigration [Borjas, Freeman and Katz, 1992] and from macro policies that produced relatively slack demand (high unemployment) in the economy as a whole, particularly in the early 1980s.

Second, many employers, particularly durable goods producers during the recessionary years of 1980-82 when the exchange rate of the dollar was at historic highs, faced a substantial increase in competitive pressures. Over the longer term, foreign economic development, technological advances in transportation and communications (facilitating trade and plant relocation), and government deregulatory policies (an outcome of the ideological shift) all contributed to this intensification of product market competition. In addition, the pressure from the financial sector on firms to maintain high profit margins — a uniquely American institutional arrangement — grew sharply in the 1980s. While economists have fiercely debated the effects of foreign trade on wages, little attention has been paid to the growing competitive pressure by shareholders on firms to adopt short-run profit maximizing strategies. Summarizing the conclusions of the time horizons project at The Harvard Business School, a research project directed by Michael Porter, Harrison writes, "real capital formation in the U.S. since the 1960s has been distorted by rules, procedures, and customs governing private sector allocation of capital... In 1960, big institutional stockholders in the U.S. — the pension and mutual funds — held on to a share on average for seven years. By the 1980s, the average period had fallen to only about two years" [1992].

The response by many employers to this new ideological, political and economic context was to make wage and benefits cuts a top priority. Wage norms shifted downward and employment security all but disappeared. As Kochan, Katz, and McKersie write, "Now more than ever, the U.S. labor market is a place where anything and everything goes" [1994, xii]. They note that although some firms adopted "high-road" employment policies and maintained or increased real wage levels, many others took the "low-road" and instituted employment policies aimed at reducing short-run labor costs by cutting wages and benefits, outsourcing, relocating to low-wage regions, and substituting contingent for permanent employees. According to the authors, the newly dominant position of employers in the 1980s reflects a "managerial autocracy common to the early twentieth century" [*ibid.*]

The following passages point to a profound shift in management's approach to labor relations that began in the late 1970s and suggest a powerful role for shifts in social norms and institutional rules. Daniel Mitchell describes the increasingly confrontational approach of employers:

> the longevity of the (wage) concession movement and its spread to less-than-dire situations suggest that the initial concessions have encouraged other employers to try their luck in demanding similar settlements.... Management, cheered by what is perceived as a shift in the balance of power, has changed its bargaining goals.... The political and legal climate change has been reflected in a greater willingness of management to take actions in labor disputes that might not have been publicly or politically acceptable in the past... Even firms with a long history of unionization are using nonunion labor. [1985]

At the end of the decade, Michael Wachter and William Carter refer to a fundamental shift in human resource policies within firms as well as the legal rules governing employment practices:

> Until the late 1970s or 1980s, firms rarely made use of their rights under Mackay Radio to hire permanent replacements. Instead, firms used managers to replace striking workers temporarily. When replacement workers were hired, they were seldom offered permanent jobs. When strikes occur today, replacement workers are more likely to be offered permanent jobs.... The rules governing plant closings and relocation are based on newer decisions.... In simple terms, the rules mean that management decisions to implement partial plant closing, work relocation, asset sales, and even some types of subcontracting are not mandatory topics (for bargaining). [1989]

The results of Luria's [1996] research suggests that, at least among smaller firms, the "rules of the game" have shifted in favor of establishments that do not invest in machinery or workers, but compete exclusively on the basis of short-run unit costs. Based on such criteria as rates of investment in machinery with computer controls, skill requirements and the percent of sales from new products, Luria finds that small manufacturing establishments can be grouped into three categories: High Road, Low Road, and Lean Commodity (Low Road shops that have adopted better management methods designed to "root out waste"). In sharp contrast to the skill-biased technological change story, Luria's results suggest that in manufacturing, part of the explanation for the wage collapse stems from the fact that *High Road producers are losing the competitive battle.* As he puts it,

> Our data suggest that...both the low- and high-roaders are gradually ceding market share to the lean commodity shops. With low-road shops quoting low-ball prices to win jobs, managers of better-run, smaller manufacturing companies face the huge strategic decision of whether to join them or fight them. An increasing number opt to join... the impact is clearly negative for wages and only slightly less so for productivity.... markets are not offering meaningful incentives for "good" manufacturing behavior ... resulting in lower wages, lower productivity, less technical change, and a composition of output that has too few products that command price premiums in global trade. [*ibid.*]

While this institutionalist account of the wage collapse is not nearly as elegant as the simple skill-biased technological change story, it has a number of advantages. First, unlike the demand shift explanation, it is consistent with the observed stability of the skill mix since the early 1980s. Indeed, it is the institutionalist hypothesis that shifts in bargaining power and wage norms and not shifts in the low-skill job opportunities underlie the wage collapse. Second, unlike explanations that rely on a simple

competitive labor market vision, it is consistent with evidence that wages reflect management competitive strategies that can be shown to vary from high road to low road for shops producing the same product for the same buyers. Third, this variation across firms in competitive strategies (and labor relations policy) is consistent with the striking growth in within-group inequality — the difference in pay among workers, for example, of the same gender, with the same education, and in the same industry. And fourth, this "low-road" account is consistent with the fact that, although all developed countries have adopted the same new information technologies and have confronted the same pressures from globalization, only in the United States have real wages declined in the 1980s — a decline that has been both massive and long-term.

CONCLUDING REMARKS

The evidence presented in the first three sections does not offer much support to the conventional view that wage restructuring of the 1980s was primarily the result of technology-induced shifts in the demand for skills. Indeed, we suggest that the wage restructuring of the 1980s was largely *independent* of skill restructuring. In our alternative account, termed by Gordon [1996] the "low-road hypothesis," the forces of demand and supply set only the limits of the space within which wage-setting occurs, and labor market institutions, management strategies and social norms all play central roles in determining the levels at which the wages of particular groups of workers are actually set. In this account, fundamental changes in these institutions, strategies, and norms began to take place in the late 1970s, reflecting both a broader, national shift towards laissez-faire values and policies and an increase in competitive pressures. Further, these two sources of the wage collapse are closely related, since the rise in competitiveness reflects the increasing importance of foreign trade, the effects of deregulation, and the increasing demands of the financial sector — all of which reflect or were strongly influenced by the shift to pro-market government policies since the late 1970s.

The implications of these two alternative explanations of the wage collapse for labor policy are profoundly different. If the rising incidence of low wages and the growth of earnings inequality over the last two decades can be attributed to declining job opportunities for low-skilled workers due to technological change, the solution is straightforward: we must increase the number and quality of applicants for the growing pool of high skilled jobs. A skill-shift story calls for a supply-side remedy of more and better education and training. In sharp contrast, an institutional explanation in which value shifts and public policy shifts play central roles suggests that reversing the wage collapse requires public policies that address not just what workers bring to the workplace, but the way wage-setting institutions work both inside and outside the firm.

While the details of a "re-institutionalization" program need careful debate, the direction seems clear. Collective bargaining sets wage and employment conditions for 18 percent of American workers. In contrast, it covers more than 80 percent of workers in Sweden, Germany, Belgium, France and Austria [Freeman, 1994]. The minimum wage in France is set at 60 percent of the average wage, almost twice as high as that in the United States. Low-skilled workers in these nations showed no declines in real earnings.

It is often claimed, of course, that a high price would be paid for maintaining traditional shelters from wage competition for low-wage workers in the current period. According to this view, the unemployment problems of a number of Western European nations reflects the effectiveness of their labor market institutions in preserving wage levels (and the wage structure) in the face of the same declines in labor demand facing low-skilled workers in the United States. This is an important concern — there is surely a threshold beyond which the value of the minimum wage, for example, would generate prohibitively large employment losses. But it is worth noting that recent research raises substantial doubt about this wage-rigidity explanation for European unemployment [Howell, Duncan and Harrison, 1998]. For instance, if higher unemployment in France than the United States was due to the more inflexible wages of low-skilled workers in France, employment patterns should be different — there should be greater declines in low-skill employment in France than the United States. Recent research has not supported this prediction.[13]

Faced with an increasingly competitive world, U.S. policy makers in the public and private sectors adopted practices that reshaped the way our labor market works. In the 1980s, the United States moved from the most decentralized labor market among developed countries even further away from our major competitors. Low-skilled workers have paid the price for these new practices in the form of sharply declining living standards. As David Gordon tirelessly reminded us, unfettered markets are not always the most efficient alternative; too much competition in the labor market can undermine the living standards, morale, on-the-job skill acquisition, and teamwork in the workplace, and consequently can undermine the productivity of the workforce. Too much wage competition may also undermine our ability to prepare the next generation for productive work and citizenship.

NOTES

1. This was calculated by taking Office, Computing and Accounting Machinery per full-time equivalent worker. The investment series is from the U.S. Bureau of Economic Analysis, "Investment by Industry Type"; employment data are taken from the National Income and Product Accounts, Bureau of Economic Analysis.
2. The timing of these employment and investment trends is also relevant to the interpretation of the regression results presented in the Berman, Bound and Griliches study. They regress the 1979-87 change in the nonproduction share of employment across industries on the level and change in the share of computers in total investment. The coefficients are positive, and they conclude that this measure of technological change accounts for "one-quarter to one-half of the within-industry move away from production labor that occurred over the 1980s" [1994, 27]. Is it plausible that investments in computers, which took place almost entirely after 1982, can explain up to half of the shift away from production labor, which occurred entirely before 1983? Interestingly, they note that their 1977-87 computer variables as well as their 1974 measure of R&D are also powerful predictors of nonproduction employment trends for 1959-73, a period in which the investment in computers as a share of total investment was negligible [Oliner and Wascher, 1995].
3. Using the same DOT-based skill measures as Howell and Wolff [1991a] and following the methodology of Karoly [1992], Wieler [1993] found that changes in the distribution of skill requirements from

1982 to 1990 were unrelated to the large and significant increases in wage inequality within industries over this period.

4. Oliner and Wascher [1995] argue, however, that this is a poor measure; substituting a more meaningful statistic, the current dollar value of computers in net capital stock, shows an increase in the share of computers in total investment from just .8 percent in 1980 to 1.9 percent in 1990. This raises the question of whether such a tiny change in capital stock could possibly explain much of the economy-wide wage collapse documented in Table 1.
5. Within this framework, it is possible that in the relevant range supply is perfectly, or nearly perfectly, inelastic. If this is so, a shift in demand would appear entirely as a change in relative wages. But since the case for the demand shift story is almost always based on the concurrence of rising skill intensity and rising relative wages of the most skilled, the general presumption underlying the conventional wisdom is that the demand shift has been manifested as a substantial shift in skill mix [Berman, Bound and Griliches, 1994].
6. For example, Katz and Murphy explain changes in relative wages with a "simple supply and demand framework" which only "require(s) that observed prices and quantities must be on the demand curve" [1992].
7. These industry groups are Machinery (Machinery, Electrical Machinery and Instruments); Transportation Equipment (Motor Vehicles, Other Transportation Equipment); Trade (Wholesale, Retail); Finance (Banking, Insurance); and Business and Repair Services (Business Services, Auto Repair, Miscellaneous Repair Services). These industries accounted for 67 percent of all spending on Office, Computing and Accounting Machinery in 1992.
8. The effect of the *level* of educational attainment on the *change* in earnings can be interpreted as a measure of worker bargaining power: all else equal, higher educational attainment is associated with a greater role for specific skill requirements and greater shelter from wage competition (e.g., through the licensing and credential requirements of many professional and technical jobs). Excluding this control lowers the explanatory power of the equation but does not change the coefficients in a substantive way.
9. This alternative is more fully developed in Howell [1997].
10. See Freeman [1995]. Based on their work on the effects of minimum wage regulations, Card and Krueger [1995] concluded that "our findings call into question the standard model of the labor market that has dominated economists' thinking for the past half century."
11. According to Richard Freeman , "a wide body of research has shown that industries/firms have scope for independent pay policies, be it because they have economic rents or can strike innovative efficiency wage contracts... In a world with rents and pay discretion, and with labor market slack, institutions have greater scope to affect outcomes than in tight job markets" [1995].
12. DiNardo, Fortin, and Lemieux [1996] find that this decline explains between 19 and 25 percent of the change in the standard deviation of men's wages and between 30 and 36 percent of the change in the standard deviation of women's wages over this period.
13. According to the Card, Kramartz and Lemieux, "the pattern of employment-population growth rates across age-education cells in France is almost identical to the pattern in the United States. Taking the evidence for the United States, Canada, and France as a whole, we conclude that it is very difficult to maintain the hypothesis that the "wage inflexibility" in Canada and France translated into greater relative employment losses for less-skilled workers in these countries" [1995].

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