POWER, EMPLOYMENT, AND ACCUMULATION

Social Structures in Economic Theory and Practice

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SKILL MISMATCH, BUREAUCRATIC BURDEN, AND RISING EARNINGS INEQUALITY IN THE U.S.

What Do Hours and Earnings Trends by Occupation Show?

I. Introduction

Since the late 1970s the U.S. labor market has been characterized by sharply declining real wages for low-skilled workers, declining shares of middle income jobs, and a dramatic increase in earnings inequality for both men and women.[1] At the same time, the quality of the workforce has risen. Test scores have been fairly stable for white workers but have risen substantially for black and Hispanic workers, and the share of the workforce with just a high school degree or less fell from 60.9 percent in 1979, to 54.6 percent in 1989, and 44.3 percent in 1997. The share of workers with college or greater rose from 16 to 26 percent over this 18–year period (Mishel, Bernstein, and Schmitt 1999).

Viewing labor market outcomes through a simple demand and supply lens, these wage and labor supply trends have led most economists to conclude that an overwhelming shift in labor demand toward workers with high cognitive skills has characterized the last two decades (for example, see Levy 1998).[2] Within the standard textbook model, a simultaneous rise in the share of skilled workers in the workplace ("skill intensity") and in the wage gap between skilled and unskilled workers (the "skill premium") makes "a prima facie case for the importance of demand shifts in explaining changes in the earnings distribution in the

U.S." (Gottschalk and Smeeding 1997, 647). In essence, the conventional account rests upon the view that there has been a protracted (2–3 decade) skill mismatch between employer demand and worker supply. This "skill-biased demand shift" explanation, briefly outlined in Section II, has dominated the academic literature and policy circles for over a decade, although direct empirical support is remarkably limited (see Howell et al. 1999; Moss 1998; Mishel, Bernstein, and Schmitt 1999).

In his book *Fat and Mean: The Corporate Squeeze of Working Americans and the Myth of Managerial Downsizing* (1996), David Gordon proposed a strikingly different explanation for rising wage inequality, one that put relative management strategy, institutional shifts, and bargaining power at center stage. In Gordon's view, declining real wages for those at the bottom of the income distribution are the result of what he called the "wage squeeze": rising inequality and declining real wages have been the consequence of a broad-based effort on the part of corporate America to lower unit labor costs in order to become more competitive.[3] Supported by government policies, U.S. corporations have taken what Gordon called "the low road," a competitive strategy exemplified by such institutional developments as the decline in the value of the legal minimum wage, the declining coverage and power of labor unions, declining job security, and the expansion of irregular (part-time and temporary) employment.

Underlying these proximate causes is the shift in bargaining power within the firm, which has manifested itself in two ways. First, in order to boost productivity in an increasingly insecure work environment, management resorted to the "stick"—adversarial labor relations strategies. These include getting tougher on wages, slashing benefits, and attacking labor unions. This stance, Gordon argues, requires an increase in the number of managers and supervisors to monitor and discipline the workforce, imposing a "bureaucratic burden" on the economy and especially on non-supervisory workers. Second, the loss of bargaining strength on the part of workers coupled with a corporate "squeeze" on wages facilitates a shift in the distribution of earnings toward the growing legions of managers and supervisors. As Gordon put it:

> The connection between the wage squeeze and the bureaucratic burden runs in both directions. In one direction, stagnant or falling wages create the need for intensive managerial supervision of frontline employees. If workers do not share in the fruits of the enterprise, if they are not provided a promise of job security and steady wage growth, what incentive do they have to work as hard as their bosses would like? So the corporations need to monitor the workers' effort and be able to threaten credibly to punish them if they do not perform. The corporation must wield the Stick. Eventually the Stick requires millions of Stick-wielders.
>
> In the other direction, once top-heavy corporate bureaucracies emerge, they acquire their own, virtually ineluctable expansionary dynamic. They push for more numbers in their ranks and higher salaries for their members. Where does the money come from? It can't come from dividends, since the corporations need to be able to raise money on equity markets. It can't come from interest obligations, since the corporations need to be able to borrow from lenders as well. One of the most obvious targets is frontline workers' compensation. The more powerful the corporate bureaucracy becomes, and the weaker the pressure with which employees can counter, the greater the downward pressure on production workers' wages. The wage squeeze intensifies. (1996, 5–6)

Gordon's vision of the dynamics of wage inequality in the United States directly challenges the conventional skill mismatch explanation. In the mainstream account, employment and earnings trends reflect the increasing demand for skill, caused principally by the growing use of new computer-based technologies. Those favored in this new economy are highly educated workers fluent in the latest information technologies. In contrast, according to Gordon, it is the top of the "top-heavy corporate bureaucracy" that is favored.[4] Some supervisory workers have more power than others, and this power includes the authority to increase their own employment and earnings.

While the skill mismatch account predicts that employment and earnings trends have most favored those commanding the skills necessary to perform in an information technology–intensive environment, the bureaucratic burden prediction is that supervisory standing will be decisive. Both perspectives appear consistent with the observed wage and employment collapse among low-skill workers, particularly in trade-sensitive industries. But according to Gordon's vision, employment and wage trends among non-supervisory workers should reflect less the level of skill a worker has to offer than the institutional shifts that have followed in the wake of the employer offensive. In sum, Gordon's bureaucratic burden story produces two separable predictions: (1) at the top of the distribution, employment and wage growth will reflect supervisory level (the "supervisory burden" prediction); and (2) among non-super-

visory workers, the extent of employment and wage declines will reflect exposure to wage competition from the institutional trends that have reflected management's offensive (the "low-road" hypothesis).

Despite the wide acceptance of the skill mismatch account, we are aware of little research that has attempted to confirm it by observing patterns of wage and employment growth across the job structure.[5] In this paper, our main goal is to assess the conventional skill-biased technological change hypothesis with U.S. occupation data for the 1970–97 period. At the same time, these data allow us to assess the empirical support for Gordon's "supervisory burden" and "low-road" hypotheses. While some of our results are suggestive of the possible roles played in recent employment and wage trends by the specific institutional shifts Gordon calls attention to, we will address this more systematically in a forthcoming paper.

Our approach to testing the strength of the statistical links between skill and supervisory levels and employment and wage growth is to group workers by job, measured as narrowly defined occupations or, better yet, as occupation-industry cells (Howell and Wolff 1991; Gittleman and Howell 1995; Howell and Wieler 1998). We begin with individual-level data grouped by job category, using four alternative levels of Census occupation and industry detail: 13 one-digit large occupation groups; 44 two-digit occupation groups; 390 three-digit occupations; and 450 three-digit occupations in which the 6 largest occupations are broken out by industry group. We use the outgoing rotation group (ORG) data from the Current Population Survey (CPS) for our analyses of the 1984–92 and 1989–97 periods, and March CPS data (corrected for occupation redefinitions) for three alternatively defined periods: 1970–79, 1979–86, and 1986–94.

While distinguishing workers by "skill" lies at the heart of the conventional demand shift story, it is both poorly defined and poorly measured in the literature. We try to improve upon this record by adopting four alternative measures of job-related skill: "Factor 1," a measure of "substantive complexity" derived from a factor analysis of skill measures from the 4th edition of the *Dictionary of Occupational Titles* (U.S. Department of Labor); the average occupation National Adult Literacy Survey score (National Center for Education Statistics); the share of job employment with greater than a high school degree; and the mean hourly wage.

The remainder of the paper consists of four sections. Section II lays out in more detail the implications of the conventional model. Section III describes our data and outlines our method. Section IV presents our results. In the first part of Section IV we summarize our findings on hours and wage growth for the 1984–97 period (separately for 1984–92 and 1989–97). In the second part we do the same using a different data set for the 1970–94 period (separately for 1970–79, 1979–86, and 1986–94). In Section V we conclude with a brief discussion of the results.

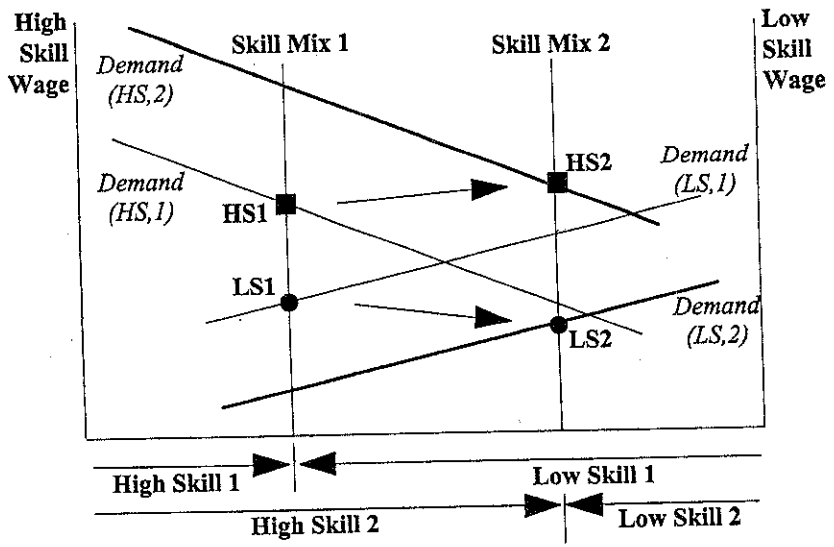
II. Implications of the Conventional Supply and Demand Model

The conventional wisdom is a skill mismatch story: the distribution of skills in the American labor force has simply not kept up with the skill needs of employers. As Rebecca Blank has put it, "Fundamentally, the demand for less-skilled workers appears to be declining faster than the number of less-skilled workers, and their wages are therefore drawn downward" (Blank 1994, 173).

Within the textbook competitive model, which has framed most of the recent research in the inequality area, there *had* to be a demand shift toward skilled workers that dominated the observed shift in supply toward the skilled in order to accommodate the observed rise in the relative (skilled/unskilled) wage. One way to show this appears in Figure 2.1 (derived from Snower 1998, figures 1–3). There are two categories of worker, those with high skills (the left side) and those with low skills (the right side, read from right to left). The horizontal axis shows employment for these two groups. The vertical lines indicate a movement toward greater "skill intensity": the share of high-skill workers increases from "skill mix 1" to "skill mix 2," which is consistent with the above mentioned decline in the share of workers with a high school degree or less.

At the same time, we know that during the 1980s, high-skill workers (college or more) experienced a real wage increase of about 5 percent, while low-skill workers were faced with a much larger 20 percent wage decline (Gottschalk 1997). Within this framework, these wage outcomes require sizable demand shifts: upwards for high-skill workers and downwards for the least skilled. With the high-skill wage on the left axis and the low-skill wage on the right, wage change for each group is depicted as an upward movement between points HS1 to HS2 for high-skill workers, and a downward movement from LS1 to LS2 for low-skill workers. The growth in wage inequality is shown by the difference between the gap between LS1 and HS1 at "skill mix 1" compared to LS2 and HS2 at "skill mix 2."

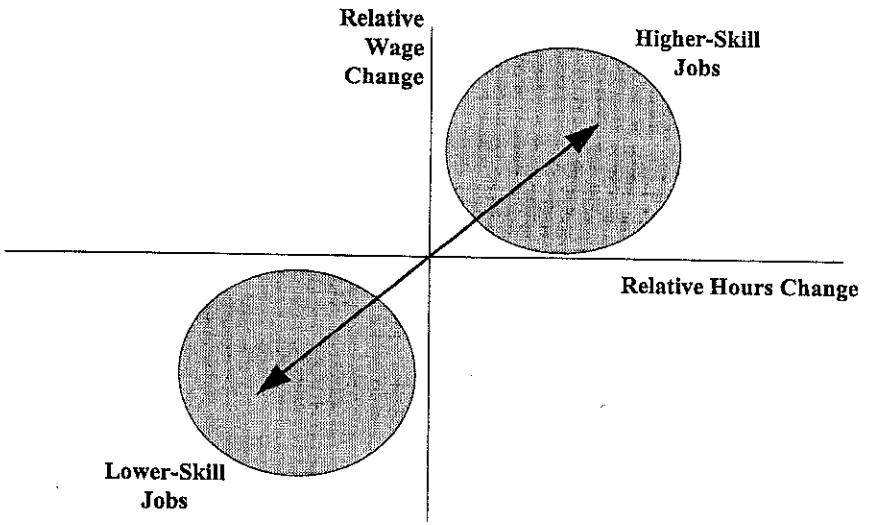
Figure 2.1 **Skill Premia and Skill Intensity: The Demand-Shift Explanation**



What could cause such a massive shift in the demand for skill? There is a broad consensus that the main culprit can be found in computer-based production technology.[6] As Bound and Johnson (1995, 12) put it, "At the risk of arguing tautologically, the source of this shift *had* to be technology" (emphasis in original).

In sum, the conventional view is that the massive restructuring of wages in recent years reflects a skill mismatch—too many low-skill workers chasing too few low-skill jobs (and vice-versa for high-skill workers)—caused mainly by skill-biased demand shifts that reflect some combination of technological change and globalization. This view implies the following three predictions that we assess in this paper. First, we should observe a strong and positive association between wage change and employment (hours) growth. Second, we should observe a strong association between the cognitive skill level of jobs and their rate of employment (or hours) and wage growth.[7] This suggests that across jobs, wage and employment (hours) growth should be strongly positively related to the skill levels. Thus, plotting wage change on the vertical axis and hours growth on the horizontal (both measured relative to the average for the economy as a whole), we should observe jobs arrayed by skill level from the upper right hand corner of the northeast quadrant (those with the greatest wage and hours growth) to the lower left hand

Figure 2.2 **The Skill-Biased Demand-Shift Prediction**



corner of the southwest quadrant (those with the lowest wage and hours growth). This is depicted in Figure 2.2.

The third prediction is that if the hypothesized demand shifts are primarily driven by the computerization of the workplace and globalization of the economy, then as these factors intensify over time, the positive relationship among skills, hours growth, and wage growth should also get stronger over time.

III. Data and Method

Our principal data are the outgoing rotation groups (ORG) of the Current Population Survey (CPS). Merged over 12 months, the ORG data offer a much larger sample than the other typical source of annual labor force data, the March CPS (140,000 observations, about 3 times the March figure). In addition, the ORG contains a direct measure of the hourly wage (in the previous week) for workers paid by the hour, whereas with the March CPS, the respondent is asked to recall last year's annual earnings, weeks worked, and usual hours per week, from which an approximate hourly wage can then be calculated (see Webster 1998).

We use data for all wage and salary workers with a strong labor market attachment. Self-employed are excluded. Included in our samples

are those aged 16–64 who usually worked between 10 and 79 hours per week, who were not self-employed, and who earned at least one-half the minimum wage. For those with top coded earnings (e.g., the maximum weekly wage is coded at $999 per week in 1984, $1,923 in 1989), we use the Pareto-imputed mean from the upper tail of the earnings distribution (Webster 1998, Table B-2). This offers a better estimate of the top of the distribution, but in a period of rising relative earnings among those with the highest earnings, this procedure will still result in a downward bias (earnings will have increased more rapidly at the top than our data show). Hours and wage growth are measured simply as the annual percentage change of a given occupation relative to the economy-wide average. The formula for relative wage change is:

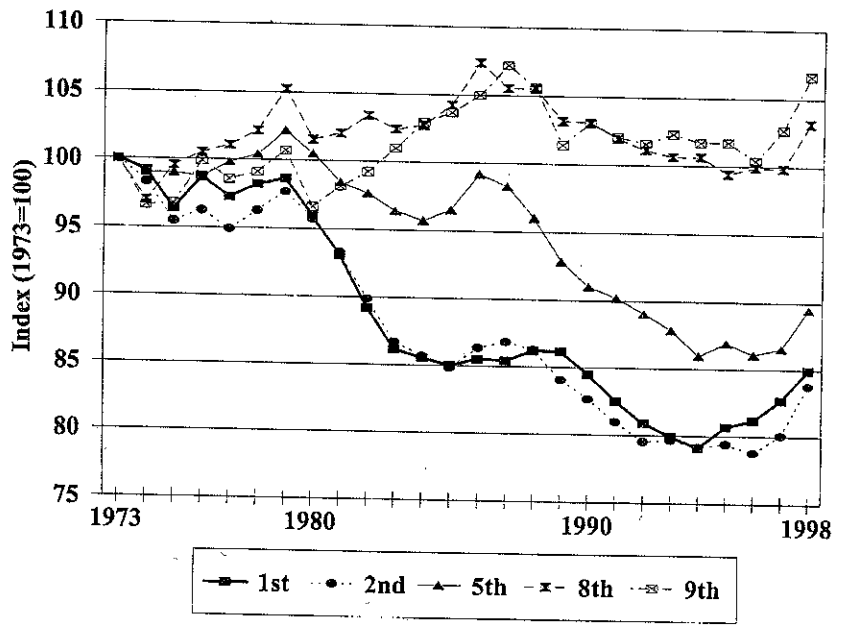
$$(1) \qquad \frac{100 \times [(W_i/W)^{t2}/(W_i/W)^{t1}] - 1}{t2 - t1}$$

where W_i is the occupation i wage, W is the economy-wide average, $t2$ is the last year of the period, and $t1$ is the initial year. The relative hours change measure is calculated similarly and indicates the change in total weekly hours worked in occupation i relative to the change in total weekly hours.

Three considerations determined our decision to focus most of our work on the 1984–97 period. First, there were extensive revisions in the Census occupation classifications that went into effect in the 1983 CPS. There are various (imperfect) ways to adjust the classifications to get consistency with earlier years, and we will present the results for such data in Section IV. But the bulk of our analysis is done with the "cleaner" 1980 classifications (with minor adjustments for changes made in the 1990 Census).

The nature of this limitation to the period since the 1980–82 recession can be seen in Figures 2.3 and 2.4. Figure 2.3 shows that male earnings inequality as measured by the 90/10 ratio took off in 1979, reflecting mainly the collapse at the bottom of the distribution during and just after the 1980–82 recession. This recession was particularly severe, and the wage and employment restructuring that took place during these years reflected the downturn as well as the adjustments firms made in reaction to the high inflation years of the 1970s (particularly for unionized firms whose workers were protected by cost-of-living contracts) and the sharp decline in trade competitiveness (following the

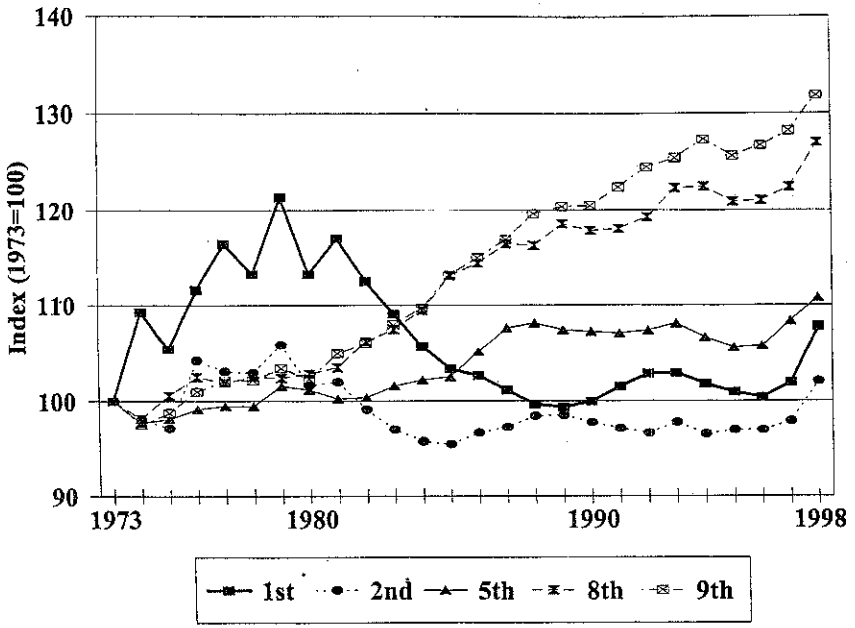
Figure 2.3 **Hourly Real Wage Decile Cutoffs, Male Workers** (1973=100)



rise in the value of the dollar). Since computers did not play a substantial role in determining skill requirements in most workplaces until at least the mid-1980s, it seems clear that if technological change in the workplace played the key role in causing the demand shift, it would be observed after the 1980–82 recession.

As Figure 2.3 indicates, the decline in male real hourly wages at the tenth and twentieth percentiles continued in the late 1980s and early 1990s. It also shows a pronounced decline in the middle of the distribution. In 1996 dollars, the typical 1st decile worker experienced a decline from $5.37 in 1984 to $5.12 in 1996; the 2nd decile worker from $7.47 to $6.94; and the median (fiftieth percentile) worker from $13.73 to $12.62. In contrast, the ninetieth percentile worker saw an increase from $28.26 to $29 (Bernstein and Mishel 1997, Table 6). Figure 2.4 shows that for women, the growth in inequality since 1979 took place mainly after the recession, as real wages fell at the tenth percentile between 1982 and 1987, and rose steadily at the eightieth and ninetieth percentiles from 1982 through 1994. Our concern in this report is primarily with the post-recession (after 1983) rise in inequality. As Philip Moss

Figure 2.4 **Hourly Real Wage Decile Cutoffs, Female Workers** (1973=100)



(1998, 24) has put it, "A reading of the statistical literature leaves the reader with a host of concerns with the explanations of why inequality continued to rise after the economy recovered from the severe 1981–82 recession."

For our analysis of the period since the 1980–82 recession, we chose to examine two overlapping intervals, 1984–92 and 1989–97. The endpoints of the former are relatively high unemployment years just after recessions (mid-year unemployment was 7.5 percent in 1984 and 7.7 percent in 1992); the more recent period is defined by business cycle peak years (5.2 percent unemployment in 1989 and 4.9 percent in 1997). In Section IV below, we supplement our examination of wage and hours change by occupation for these two recent periods with one that reports wage and employment change between 1970 and 1994. This is useful not only because it adds a decade and a half but also because it measures demand shifts by employment rather than hours and it employs different dates. These differences provide a further check on the robustness of our results for the recent periods. The longer term data is defined for three periods: 1970–79 (mid-year unemployment rates of 5.0 and 5.7), 1979–86 (5.7 and 7.0), and 1986–94 (7.0 and 6.1).[8]

A unique characteristic of this study is our use of alternative measures of "skill." We use two conventional *indirect* measures of worker skill: the mean wage for the job and the percentage of the employed workforce in the job with more than a high school degree (% > HS). The former presumes that workers in the job will tend to be paid their marginal product, which in turn should closely reflect the skills and other work-related traits of the typical worker employed in the job. The educational attainment measure is also indirect, since its use presumes that across the job structure more years of schooling are closely associated with higher levels of work-relevant skills, and hence higher productivity, for which the employee is actually paid.

These two measures may not adequately capture differences in the skills valued by employers; educational attainment measures are suspect since they do not capture a variety of workplace relevant skills, and the relative wage is unreliable because with imperfect information, limited worker mobility, and at least some role for social norms and institutions, most labor markets may not look much like the textbook model. Thus, motor skills are particularly important for some highly paid professionals (physicians, athletes) as well as many poorly paid blue-collar jobs and are not closely linked to years of schooling. Social interaction skills and emotional intelligence are central to good managerial performance (Goleman 1998). These are traits only loosely linked to years of educational attainment. Best-practice computer programmers and engineers are typically not paid nearly as much as investment bankers and corporate lawyers although years of schooling may be similar. Indeed, even relatively well-paid full-time child care workers tend to earn less than the least well-paid truck drivers, despite higher years of schooling. It seems fair to say that educational attainment and relative wages are, at best, quite rough proxies for job skill requirements.

We therefore supplement these with two "direct" measures of workplace skill. The first is a measure of cognitive skill requirements ("Factor 1," a measure of what Miller et al. 1980, term "substantive complexity"), which consists of scores on the primary factor in a factor analysis of more than forty measures of work-related skills and traits from the *Dictionary of Occupational Titles* of the U.S. Department of Labor.[9] The underlying skill measures reflect thousands of workplace interviews conducted between 1967 and 1974. Although the DOT-based measure is dated, a recent revision, based on interviews conducted in

1989 for occupations in selected high-growth, high-tech industries produced remarkably similar skill scores.[10]

Our second direct measure is the average of three indices of workplace literacy for those 16 and older (prose literacy, document literacy, and quantitative literacy) from the National Adult Literacy Survey (NALS) produced by the National Center for Education Statistics.[11] The literacy measures are based on large-scale national surveys conducted in 1992. Occupation scores are the mean of the scores for each individual in the occupation.

Table 2.1 presents simple correlations among these four skill measures, relative hours change and relative wage change. The two panels in the top half of the table present results weighted by hours worked for 1984–92 and 1989–97. The bottom two panels present the unweighted results. The four skill measures are highly correlated but far from identical. Surprisingly, Factor1, derived from shopfloor interviews between 1966 and 1974, is more highly correlated with the 1992 wage measure than NALS, our functional literacy measure that dates from the same year (e.g., in the weighted correlation, Factor1 and Wage92 have a coefficient of .81, compared to a NALS and Wage92 coefficient of .72). On the other hand, NALS and %>HS are nearly perfectly correlated (.91). Prefiguring results presented below, the last two rows of each panel in Table 2.1 show the correlations between skill measures and wage and hours change. Although statistically significant, the coefficients for wage change and the various skill measures are modest: .47 for %>HS and .38 for NALS in the first period; and .26 and .22 respectively in the second. These results show a substantial decline in the size of the coefficient between the 1980s and 1990s, the reverse of what we would expect on the basis of the skill-biased technological change hypothesis.

Finally, we began this project with the assumption that greater occupation (and industry) detail would provide a clearer picture of the kinds of jobs experiencing wage and employment growth and decline. It is possible, however, that at finer levels of occupation detail, workers doing similar work may get allocated to the wrong occupations. In other words, disaggregation may increase error in the data. A test for within- vs. between-group variation (anova) offers a simple way to determine whether greater disaggregation produces more meaningful (homogeneous) groups: within-job share of wage variance should decline as the level of detail increases. Table 2.2 presents results for four levels of occupation aggregation for 1984, 1989, 1992, and 1997. The results show that disaggregation is clearly associated with less within-group variation for both male and female workers and for each of the four years. At least concerning wages, then, more detailed occupations are more homogeneous. Interestingly, however, the share of total wage variance that occurs within occupations grows substantially over time, particularly between 1992 and 1997.[12]

Table 2.1

Correlations Between Different Skill Measures

Panel A: Total Workers, 1984–92 (weighted by total weekly hours, 1992)

Variable[a]	Wage92	%>HS	NALS	Factor	Relative wage change[b]	Relative hours change[b]
Wage92	1.000					
%>HS	0.748	1.000				
	0.00					
NALS	0.719	0.910	1.000			
	0.00	*0.00*				
Factor	0.812	0.768	0.780	1.000		
	0.00	*0.00*	*0.00*			
Relative	0.244	0.469	0.378	0.237	1.000	
wage change	*0.00*	*0.00*	*0.00*	*0.00*		
Relative	0.180	0.296	0.271	0.168	0.102	1.000
hours change	*0.00*	*0.00*	*0.00*	*0.00*	*0.04*	

Panel B: Total Workers, 1989–97 (weighted by total weekly hours, 1997)

Variable[a]	Wage97	%>HS	NALS	Factor	Relative wage change[b]	Relative hours change[b]
Wage97	1.000					
%>HS	0.789	1.000				
	0.00					
NALS	0.738	0.916	1.000			
	0.00	*0.00*				
Factor	0.832	0.786	0.792	1.000		
	0.00	*0.00*	*0.00*			
Relative	0.059	0.261	0.220	0.103	1.000	
wage change	*0.24*	*0.00*	*0.00*	*0.04*		
Relative	0.233	0.299	0.287	0.247	–0.057	1.000
hours change	*0.00*	*0.00*	*0.00*	*0.00*	*0.26*	

Source: Current Population Survey, Outgoing Rotation Group data.
Notes:
[a] The level of significance is indicated in italics below correlation coefficient.
[b] Relative wage and hour changes are measured as the annual percentage change in the occupation wage (hour) relative to the economy-wide average, weighted by total weekly hours in the end year of period change.

Table 2.2

Within-Group Share of Wage Variance by Level of Occupational Detail

	1 Digit	2 Digit	3 Digit	Modified 3 Digit
Panel A: All Workers, 1984–97				
1984	60.8	55.7	52.0	50.4
1989	62.7	57.1	53.6	52.2
1992	62.4	57.2	53.8	52.2
1997	71.1	66.2	63.9	61.8
Panel B: Male Workers, 1984–97				
1984	78.1	73.9	69.7	67.6
1989	80.1	74.7	70.5	68.8
1992	76.6	71.7	67.5	65.5
1997	88.7	84.3	81.0	79.1
Panel C: Female Workers, 1984–97				
1984	27.1	25.5	23.6	23.2
1989	32.5	29.8	27.9	27.4
1992	38.3	35.4	33.4	32.8
1997	43.4	40.8	38.8	38.2

IV. Results: Patterns of Hours and Wage Growth

In this section we examine patterns of hours and wage growth at varying levels of occupation and industry detail for 7–9 year periods between 1970 and 1997. We begin with two periods for which we are able to use 1980 occupation classifications with the MORG (merged outgoing rotation group) data, 1984–92 and 1989–97. We examine hours and wage change for four alternative levels of job aggregation for these two periods: one-digit occupation groups (13 occupations), two-digit occupation groups (44 occupations), three-digit occupations (392 occupations), and modified three-digit occupations (450 occupations).[13] In the second part of this section, we examine changes in employment (rather than hours) and do so with a consistent set of detailed (three-digit) occupations for a much longer time frame, 1970 to 1994. The latter are subdivided into three periods, 1970–79, 1979–86, and 1986–94.

Hours and Wage Change, 1984–97

Large Occupation Groups (one-digit)

Table 2.3 presents weighted regression estimates of relative wage change on relative hours growth for male, female, and all workers, using four

Table 2.3

Regression Results by Level of Aggregation

Panel A: One-Digit Major Occupation

		1984–92				1989–97			
		Coeff.		S.E.	Adj. R^2	Coeff.		S.E.	Adj. R^2
Total (n=13)	Wtd.	0.219	***	0.090	0.290	0.194	***	0.081	0.282
	Unwtd.	0.062		0.131	–0.069	0.053		0.180	–0.082
Male (n=13)	Wtd.	0.186		0.112	0.127	0.352	***	0.109	0.441
	Unwtd.	–0.221		0.125	0.149	0.651	***	0.226	0.377
Female (n=13)	Wtd.	0.153	***	0.055	0.359	0.131	***	0.052	0.307
	Unwtd.	0.126		0.066	0.183	0.009		0.111	–0.090

Panel B: Two–Digit Occupation Groups

		1984–92				1989–97			
		Coeff.		S.E.	Adj. R^2	Coeff.		S.E.	Adj. R^2
Total (n=43)	Wtd.	0.091		0.052	0.045	0.086	**	0.045	0.060
	Unwtd.	0.120	**	0.058	0.070	0.024		0.049	–0.018
Male (n=43)	Wtd.	0.061		0.054	0.006	0.121	**	0.057	0.079
	Unwtd.	0.071		0.062	0.007	0.089		0.063	0.024
Female (n=43)	Wtd.	0.081	***	0.035	0.092	0.063	**	0.032	0.066
	Unwtd.	0.097	**	0.046	0.076	–0.048		0.074	–0.014

Panel C: Three–Digit Occupation Groups

		1984–92				1989–97			
		Coeff.		S.E.	Adj. R^2	Coeff.		S.E.	Adj. R^2
Total (n=392)	Wtd.	0.022	**	0.011	0.008	–0.011		0.010	0.001
	Unwtd.	0.036	***	0.014	0.014	–0.001		0.014	–0.003
Male (n=358)	Wtd.	0.002		0.011	–0.003	0.002		0.015	–0.003
	Unwtd.	0.015		0.015	0.000	–0.004		0.018	–0.003
Female (n=258)	Wtd.	0.018		0.011	0.007	–0.016		0.009	0.008
	Unwtd.	0.018		0.015	0.002	–0.016		0.012	0.003

Panel D: Modified Three–Digit Occupation Groups[a]

		1984–92				1989–97			
		Coeff.		S.E.	Adj. R^2	Coeff.		S.E.	Adj. R^2
Total (n=450)	Wtd.	0.024	***	0.007	0.024	–0.012		0.010	0.001
	Unwtd.	0.025	***	0.010	0.013	–0.008		0.014	–0.002
Male (n=406)	Wtd.	0.003		0.011	–0.002	0.014		0.014	–0.002
	Unwtd.	0.002		0.015	–0.002	–0.011		0.017	–0.002
Female (n=282)	Wtd.	0.013		0.008	0.006	–0.014	*	0.009	0.005
	Unwtd.	0.013		0.010	0.002	–0.013		0.012	0.001

Source: Authors' analysis of Current Population Survey outgoing rotation group data.

Notes: Relative wage and hour changes are measured as the annual percentage change in the occupation wage (hour) relative to the economy–wide average, weighted by total weekly hours in the end year of period change.

*** indicates significance at 1 percent level, ** at 5 percent, and * at 10 percent.

[a] Includes the six largest occupations broken down into 2–15 individual occupation groups.

levels of disaggregation of occupation groupings.[14] We begin with the most aggregated (and therefore most heterogeneous) Census occupation categories. The first column in Panel A shows the results for total, male, and female workers at the one-digit level (thirteen large occupation groups). The positive coefficient in both time periods and for all groups (total, male, female) is consistent with the conventional view that skill-biased demand shifts have led to a (positive) association between wage and employment growth across occupations, as diagramed in Figure 2.2. However, it is only the weighted results that are consistently strong; for the tests across occupations treated equally (not weighted by employment size), the results are strongly positive only for males in the 1989–97 period. The weighted results show about the same relationship between hours change and wage change across occupations for men and women in the 1984–92 period: a 10 percent increase in hours worked (relative to the economy average) was associated with a 1.8 percent increase in wages (relative to the average) for men and a 1.5 percent increase for women. For the 1989–97 period, this association strengthened considerably for men (to a 3.5 percent increase) and fell slightly (to a 1.3 percent increase) for women.

A closer look at where the occupation groups fall around the estimated upward sloping line is instructive. Figures 2.5 and 2.6 present scatter plots for relative hours and wage change for the thirteen large occupation groups for the 1984–92 and 1989–97 time periods, respectively. For each quadrant, we report total weekly hours worked in the occupation groups in the final year of the period, the percentage of all weekly hours worked, the number of occupation groups located in the quadrant, and the percentage of total hours worked in the quadrant by employees with more than a high school degree.

On each figure we draw an unweighted regression line on the scatterplot. This line shows little slope in either period, an impression confirmed by the negligible size of the regression statistics (for example, for 1984–92 the coefficient is .06, with a t-statistic of .47 and an adjusted R^2 of .07). Figures 2.5 and 2.6 suggest that the positive correlation between hours and wage change at this most aggregated level is driven by the performance of the large Professional/Specialty occupation group, which experienced positive hours growth and increasing real earnings.

Figure 2.5 generally supports the conventional view on the skill bias of labor demand changes in the first period under consideration (1984–92):

Figure 2.5 **Wage Change versus Hours Change, 1–Digit Level, 1984–1992**

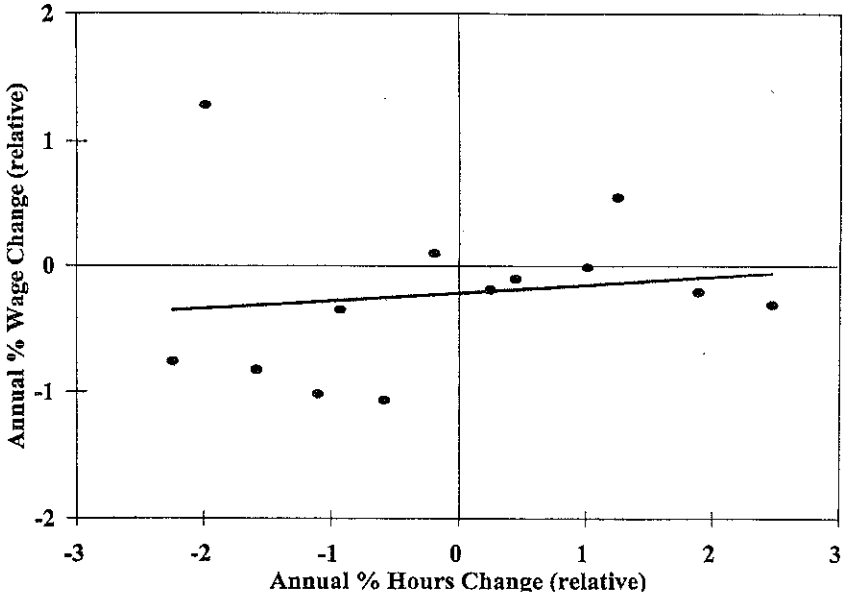
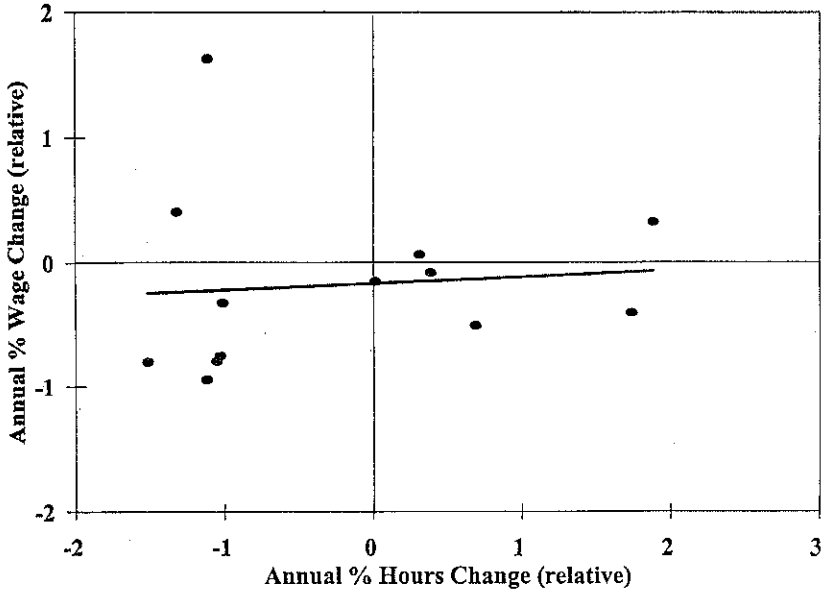


Figure 2.6 **Wage Change versus Hours Change, 1–Digit Level, 1989–1997**



the occupations with the highest wage and hours growth clearly employed the most educated workers. Some 92 percent of hours worked in the northeast quadrant in the first period were by those with more than a high school degree; this compares with just 26 percent in the southwest quadrant. In the more recent period (1989–97, Figure 2.6), the gap between the skill level in northeast quadrant (high wage and hours growth) and southwest quadrant (low wage and hours growth) narrows: 78 percent of hours worked in the northeast and 39 percent in the southwest quadrants were by workers with more than a high school degree.

Perhaps the most striking result at the one-digit level is that occupation groups are not clearly concentrated in the northeast quadrant (characterized by relatively high hours and wage growth) and southwest quadrant (characterized by relatively low hours and wage growth) in either period, as would be the case if wage and hours changes were mainly the result of demand shifts (as diagramed in Figures 2.1 and 2.2 above). Indeed, 56 percent of total weekly hours in 1992 were worked in occupations in which relative hours and wage growth had opposite signs in the 1984–92 period (that is, they appear in the northwest and southeast quadrants of Figure 2.5). This drops to 31 percent in 1997 for the 1989–97 period.

The same job classification title may be substantially different in earnings and skill levels for male and female job holders. For both male and female workers, there were substantial hours worked in the low wage growth/high hours growth occupations (the southeast quadrant). Furthermore, the concentration of hours worked in these southeast quadrant jobs increased noticeably from the 1980s to the 1990s, again for both male and female workers. In 1997, nearly two-fifths of male and female hours worked were in the high hours but low wage growth large occupation groups.

The large shift toward the occupations experiencing declining wages and growing hours is accounted for by modest shifts in a few large occupations. For men, the Executives, Administrative, and Managerial Occupations category relocates from the northeast to the southeast due to a small decline in wage growth. For women, just two shifts account for most of the difference in the distribution of hours worked between the two periods including the Sales Occupations category (which moves from the southwest quadrant to the northeast quadrant).

In sum, the results at the one-digit level offer qualified support for the conventional prediction that wage and hours growth are correlated, a prediction that is consistent with the view that the last two decades have been characterized by extensive skill-biased demand shifts. Further, the stronger results in the more recent period (1989–97) for men in Table 2.3 are consistent with the view that skill-biased demand shifts have accelerated, as would be expected if computerization and globalization are the main sources of the shifts. On the other hand, nearly two-fifths of all hours worked for both men and women in the 1989–97 period were in occupations characterized by relatively high hours growth but lower than average wage growth (the southeast quadrant).

Clearly, a major problem with the one-digit classifications is the "lumpiness" of the data. Small changes in hours or wage growth can have substantial impacts on the summary statistics for each quadrant. The results should be more meaningful at the more narrowly defined two-digit level.

Two-Digit Occupations

Panel B of Table 2.3 presents the regression estimates of relative wage change on relative hours change for forty-four two-digit Census occupations groups. Both periods (1984–92 and 1989–97) show a positive but much weaker association than was found in the one-digit sample. For all workers, the results are similar for both periods: coefficients of .091 and .086, significant at just the 10 percent level, with adjusted R-squared values of only .05 to .06. The strongest results for men appear in the weighted test for the most recent period, but here the coefficient is only one-third its size in the more aggregated data for men, and the equation accounts for under 8 percent of the variation in wage growth, compared to 44 percent in one-digit data. For female workers, the more disaggregated results are strongest in the weighted equation for the early period, but the coefficient is half the size of its counterpart in the estimate for the one-digit sample and the adjusted R^2 is just one-quarter its size in the more aggregated sample. Thus, we find only a hint of a meaningful positive association between relative hours and wage growth in the two-digit data.

While the overall statistical relationship is weak, in some respects a pattern is discernable when we consider wage and hours growth in particular occupations (for reasons of space, we do not present scatterplots at the two- and three-digit levels; we return to them below, however, in

our discussion of the most disaggregated modified 3–digit results). In both periods, blue-collar occupations in the goods industries are clearly concentrated in the southwest quadrant—occupations with declines in both relative wages and relative hours. Also consistent with the conventional view, several professional occupation groups experienced positive relative wage and hours change. Most prominent among these are Health Diagnosing Occupations (doctors and dentists); Health Assessment and Treating Occupations; Teachers, except College; Other Professional Specialty Occupations; and Health Technologists. Interestingly, in both periods, managers (Other Executives, Administrators and Managers) and a large supervisory occupation (Supervisors, Sales) experienced relatively high hours growth but low wage growth. Joining them in 1989–97 were two other relatively skilled occupations: Management Related Occupations and Engineers. These results do not seem particularly supportive of Gordon's supervisory burden explanation of earnings inequality growth.

We do, however, find that employees in the occupations with the fastest growing hours and wages have the greatest educational attainment, particularly in the most recent (1989–97) period: of the workers in occupations experiencing positive growth in relative hours and wage, 91 percent had more than a high school degree. This is compared to 81 percent in the 1984–92 period. Of the workers experiencing positive hours growth and relative wage declines in the more recent period, the proportion with greater than high school falls to 68 percent and for workers in occupations with declines in relative wages and hours the figure was just 38 percent. The evidence both across occupations in the later period and across periods for the high wage and hours growth jobs is consistent with the conventional skill-biased demand shift account.

Finally, among the occupation groups with relatively slow hours growth and stagnant or rising relative wages were two moderately skilled, primarily female, administrative support occupation groups (Secretaries; Financial Records and Processing Occupations), and three extremely low-wage groups (Private Household Service Occupations; Food Service Occupations; and Farm Workers and Related Occupations). The mean wages of these last three job groups in 1992 were $5.53, $5.52, and $6.44 (1997 dollars). We speculate that the minimum wage hikes that began in 1989 may help account for their relatively large proportional wage increases. The increase in the number of occupation groups and hours worked in the second period accounted for by occupations

experiencing rising relative wages and declining relative hours (from four to eight occupation groups; from 6.7 percent to 12 percent of total hours worked) is consistent with this possibility.

As in the case of one-digit occupations, a significant percentage of all hours worked were in occupations experiencing relative wage declines along with relative hours growth. As with the more highly aggregated data, lumpiness may partly explain this result. Still the overall picture at this level of detail is that a substantial share of hours worked are in the off-diagonal quadrants, with neither positive nor negative relative wage and hours growth jobs; thus, we find that 70 percent of all hours worked in two-digit occupation groups with greater than average hours growth were also in occupation groups with lower than average wage growth.

Relating the observed pattern of wage and hours growth to the level of skills also produces a surprising result. While the expected pattern of wage levels and educational attainment shares are strongly supported for females, they are not for male workers. For men in both periods, among the occupation groups that experienced relatively high wage growth, the "skill" level (greater than high school shares) and real wage levels are similar in both slow and fast growing occupations. Indeed, in the most recent period, male workers in occupation groups with high hours growth but relatively low wage growth had the highest wages and the highest educational attainment. At the two-digit level, the pattern of relative wage change, hours change, and skill levels does not correspond well with the stylized prediction that appears in Figure 2.2.

Three-Digit Occupations

At the three-digit level we retain 392 of the 501 total Census occupations, which should raise considerably the within-group homogeneity of tasks and skill requirements compared to that of occupation groupings at the one- or two-digit level.[15] Given this greater precision, it is striking that the statistical association between relative wage and hours change is even weaker here. As the regression results shown for all workers in Panel C of Table 2.3 indicate the weighted coefficients decline from .08/.09 in the two periods with two-digit data, to –01/.02 in the three-digit data. With one exception, hours change in each of the equations in Panel C accounts for less than one percent of the variation in relative wage change. The reason for the poor statistical fit is readily apparent from the fact that nearly half of the occupations had opposite signs on

the wage and hours change measures; that is, they fall in the northwest or southeast quadrants of Figure 2.2. Further, the relationship between hours growth and wage growth appears to weaken over time. While the coefficient on hours growth for all workers is small but positive for the 1984–92 period (.022, t-statistic of 2.01), it becomes negative for the 1989–97 period. Again, a rising share of occupations that fall far from the diagonal of Figure 2.2 helps explain this weakening of an already quite weak statistical relationship.

Northeast quadrant jobs. In both periods, occupations with high wage and hours growth were the most skilled while those experiencing relative declines in wages and hours were the least skilled. This result is consistent with the skill-biased demand shift account. But there is some ambiguity. The ten largest occupations experiencing relative wage and hours growth in the 1984–92 period accounted for about half of all hours worked in 1992. The largest four of these high wage and hours growth occupations were Elementary School Teachers, Registered Nurses, Nurses Aides and Orderlies, and Miscellaneous Administrative Support workers. These are low-to-moderate wage jobs requiring relatively high social ("people") skills. They are also heavily female: 86 percent of the hours worked in these four occupations were by women in 1992. Among the other top ten occupations experiencing positive relative wage and hours growth were social workers and general office supervisors. At least for these six large occupations, it would be surprising to find that technology- or trade-driven skill-biased technological change explains their experience. With the exception of Nurses Aides and Orderlies, our NALS, DOT, and educational attainment measures indicate that these largest jobs with high relative wage and hours growth in 1984–92 required above average cognitive skills. Nor, it should be noted, does this mix of occupations appear supportive of the bureaucratic burden account.

A quite different set of jobs experienced both high wage and high hours growth in the later period, 1989–97. But among the ten largest occupations, only Computer Systems Analysts and Computer Programmers appear to fit the skill-biased demand shift prototype. Note that in the 1984–92 period, Computer Programmers had high wage growth but relatively slow hours growth and Computer Systems Analysts experienced lower than average wage growth. So even for these two information technology occupations, the relative hours and wage growth evidence is ambiguous for the decade and a half since 1984.

It is striking that four of the ten largest occupations in the high wage and hours growth group required very low skills. In these four jobs, less than half of the hours worked in 1997 were by workers with more than a high school degree. In two of these occupations (Cooks; Maids and Housemen), less than one-quarter had more than a high school degree. Their experience of relatively high wage growth again suggests that the legislated increases in the minimum wage over this period may have played a substantial role. If so, it does not appear to have greatly harmed the rate of hours growth for these occupations.

Southwest quadrant jobs. On the other hand, as predicted by both skill mismatch and bureaucratic burden explanations, many of the largest jobs with lower than average hours and wage growth were blue-collar positions requiring low cognitive skills. Still, the data present us with a more complex portrait, since the wage and hours performance of three higher skilled white-collar occupations appear tied to that of their lower-skill, blue-collar counterparts in the same industries: Sales Representatives (manufacturing, mining, and wholesale) and Supervisors in production occupations experienced relative declines in hours and wages in both 1984–92 and 1989–97. While again not supportive of a central role for supervisors in the growth in wage inequality, these results are consistent with Galbraith's industry-level findings (1998).

Further, demand is not just shifting against workers in heavy industrial sectors. Several low- to moderately-skilled white-collar jobs also saw relative hours and wage declines in both periods. In 1984–92, these jobs include Cashiers and Accountants/Auditors, and in 1989–97, Secretaries, Other Financial Officers, and General Office Clerks. This indicates that skill-biased technological change may be having its greatest impact in the office by reducing staffing requirements for moderately skilled administrative support workers.

"Off-Diagonal" quadrant jobs. The ambiguous nature of the evidence regarding skill-biased demand shifts at the detailed occupation level is underlined by examining the types of jobs located "off the diagonal": those for which relative hours growth and relative wage growth were inversely related. A wide variety of jobs appear in the northwest quadrant (relatively high wage growth but lower than average hours growth). In both periods, for example, Automobile Mechanics and Secondary School Teachers are among the largest ten jobs for men in the sample.

However, these two large occupations appear at opposite ends of the skill spectrum. Auto Mechanics have a NALS score of 263 and only 32 percent possessed more than a high school degree in 1992. Secondary School Teachers, on the other hand, have a NALS score of 326 and 99 percent hold more than a high school diploma. For female workers, we also find Secondary School Teachers in this quadrant in both periods, along with a number of much lower skill occupations, such as Child Care Workers and a variety of Sales Worker occupations. In the 1989–97 period, five of the ten largest northeast quadrant jobs for women paid between $5.72 and $7.55 an hour on average. The rising wages and declining employment experienced in these jobs may reflect the combined effects of a rising minimum wage and computerization in the stores and offices.

We also find it difficult to generalize about the jobs in the southeast quadrant—those with relatively high hours growth and below average wage growth. For men, seven of the ten largest jobs in 1984–92 and six of the ten largest in 1989–97 are relatively low-skill (with, say, less than a 300 NALS score). The two largest southeast quadrant jobs in 1984–92 were Truck Drivers and Supervisors & Proprietors, Sales. For 1989–97, the two largest were Managers, n.e.c., and Laborers, excl. Construction (in the next section we subdivide three of these—Truck Drivers, Supervisors, and Managers—by industry). For female workers, Supervisors & Proprietors and Nurse's Aides, Orderlies and Attendants were two of the largest four jobs in this high hours growth, low wage growth quadrant.

As a result of this diversity in skill requirements across occupations both between and within the hours and wage change quadrants, we find no statistical association at the three-digit level between relative wage change and hours change. Panel C of Table 2.3 shows that this holds for both unweighted and weighted (by occupation size as measured by hours worked) tests in both time periods for both males and females. Indeed, if there is any relationship for female workers in the 1989–97 period, it is negative: higher wage growth is associated with relatively low hours growth.

Three-Digit Occupations Subdivided by Industrial Sector

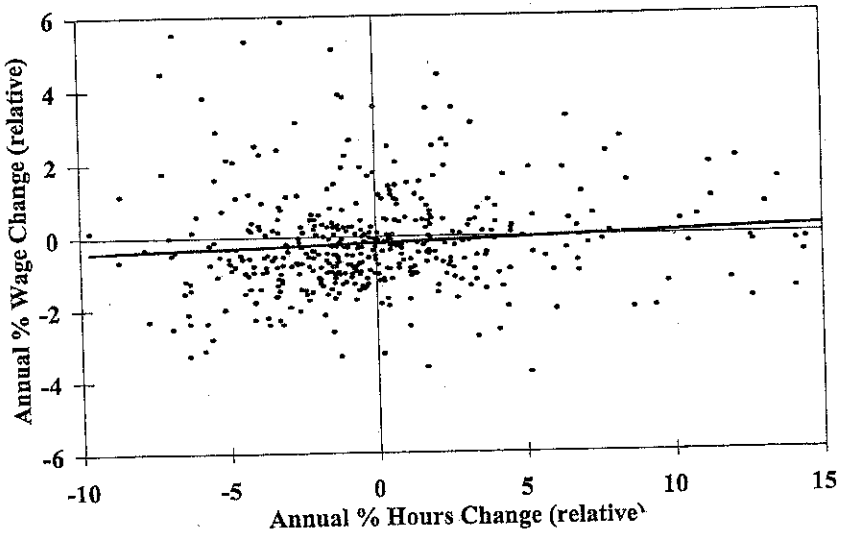
While the three-digit classifications offer considerable occupational detail, there remain some extremely large occupational groupings. For example, there were 232 million hours worked by Managers, n.e.c., in 1992, or over 6 percent of the economy-wide total. Not only does this Manager occupation dwarf all but a few of the other (391) detailed occupations, it is extremely heterogeneous. The retail and personal services/recreation sectors accounted for over 25 percent of this category in 1992, and both were growing at well above average rates in both the 1984–92 and 1989–97 periods. Yet the average wages of these two low-wage manager groups ($12.07 and $14.12) were similar to that of the best paid group of truck drivers ($12.47), despite the fact that the latter had much lower average educational attainment. In contrast, other managers included under the Managers, n.e.c. umbrella included those in Finance, Insurance and Real Estate, who earned about twice as much on average ($25.33) in 1992. While only 18 percent of these high-wage managers had just a high school degree or less in that year, 47 percent of Retail Managers and 78 percent of high-wage Truck Drivers had no more than a high school degree.

Because of this heterogeneity, we subdivided six of the largest occupations by industry sector. We subdivided the largest occupation, Managers, n.e.c., into fifteen sector groups. The next five largest occupations (Secretaries; Supervisors, Sales; Cashiers; Janitors and Cleaners; and Truck Drivers) were disaggregated into two or three large sector groups based on 1989 average sector wage levels. By subdividing these large three-digit occupations we boost the number of occupations to 450.

Scatterplots of wage and hours change for the 450 occupations for each of the two periods are shown in Figures 2.7 and 2.8. These seeming "clouds" of data points illustrate a number of important points. First, there is no clear direct relation between demand growth (hours change) and wage changes, and any hint of such a relation in the first period disappears in the more recent period. The estimated unweighted regression line drawn in the figures shows a slight positive slope in the first period and then a slight negative slope in the second period. In the first period, 43 percent of hours worked were in occupations which experienced opposite changes in hours and wages. In the second period, more than half of the hours worked (52 percent) could be characterized this way. This deterioration of the relation between hours and wage growth confirms what had been found in the analysis of the more aggregated data.

Second, the relation between demand growth and wage growth is statistically weaker at the more disaggregated level. Compare, for example, the slope of the unweighted regression lines in the analysis of the one-digit data with that at the modified three-digit level (Figures 2.5

Figure 2.7 **Wage Change versus Hours Change, Modified 3–Digit Level, 1984–1992**

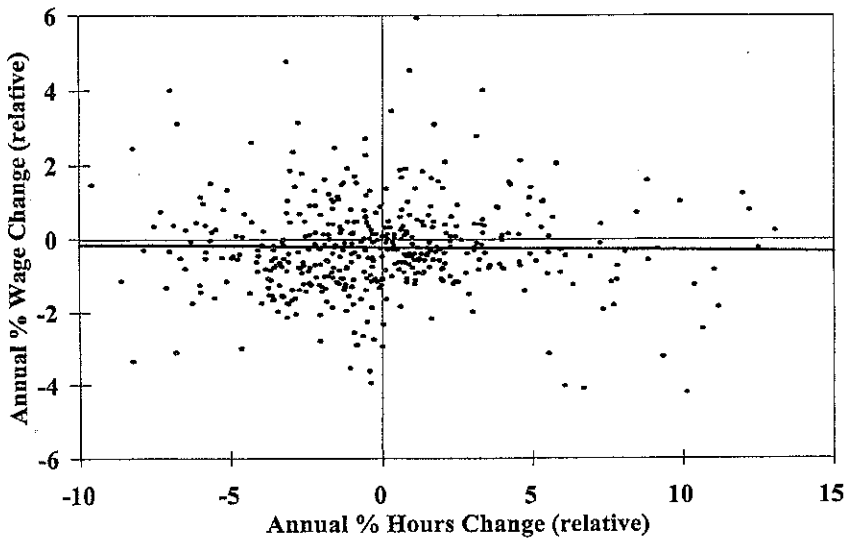


and 2.6 compared to 2.7 and 2.8). The weighted results shown in Panel D of Table 2.3 for total workers confirm this result: the small but highly significant coefficient for 1984–92 becomes negative and insignificant for 1989–97. Once again, if the skill mismatch story has strong empirical support, we would have expected that more detailed and homogeneous occupational groupings would bring more, not less, precision to the relation between hours and wage growth.

A third point relating to the scatterplots is that jobs experiencing positive wage and hours growth show much higher skill levels, on average, than jobs that suffered wage and hours declines. Among those in jobs with positive wage and hours growth in the second period (1989–97), 63 percent possessed greater than high school education, while only 43 percent of those with hours and wage declines had more than a high school education. While this would seem to support the skill mismatch theory, the picture is once again clouded by the nature of these jobs.

The jobs that have shown large and persistent wage and hours growth since 1984 tend to require relatively high skill levels, but are not generally "high-tech" (e.g., strongly engineering or computer related) or high-level supervisory jobs. Table 2.4 shows the modified three-digit occupations that experience *both* high wage and hours growth (.5 per-

Figure 2.8 **Wage Change versus Hours Change, Modified 3–Digit Level, 1989–1997**



cent or above) in *both* periods. Of the seventeen jobs that met these criteria, eleven were professionals in the health and education sectors. Three others have only low to moderate skill (NALS) scores. The only high-skill, high-tech job on the list (outside the health sector) is Mechanical Engineering Technicians, a fairly small occupation (498,000 average hours worked per week, compared to 67 million for Elementary Teachers). Nor do high-level managers (supervisors) figure prominently in this list.

If we consider only the 1990s, the ten largest high wage and hours growth jobs were Cashiers, Elementary School Teachers, Cooks, Computer Systems Analysts and Scientists, Managers (Retail), Receptionists, Social Workers, Computer Programmers, Guards and Police (except public service), and Data-Entry Keyers. While two computer-related jobs requiring at least moderate skills made this list, so did four very low skill jobs (Cooks, Cashiers, Receptionists, and Data-Entry Keyers). One managerial occupation also makes the list, but is neither a high-wage nor high-skill job. Again, we find little support for either the skill mismatch or bureaucratic burden explanation.

In the 1990s, we find more managers in the southeast quadrant, in which jobs show relatively low wage growth but high employment

Table 2.4

Occupations with Large[a] Wage and Hours Growth in Both Periods
(modified 3-digit)

	Wage change		Hours change		Skill (NALS)	Weekly hours[b]
Occupation	1984–92	1989–97	1984–92	1989–97	1992	1992
Teachers, elementary	0.63	0.95	3.24	2.03	322.5	67,200,000
Physicians	3.06	1.07	3.91	4.96	333.5	12,800,000
Teachers, special education	1.53	1.47	5.26	4.17	317.9	10,500,000
Kitchen workers, food prep	0.50	1.24	5.98	8.90	250.5	6,833,528
Pharmacists	1.50	2.00	3.37	2.43	328.9	6,253,545
Sales workers: radio, TV	1.74	1.83	1.04	1.09	303.3	5,909,862
Radiologic technicians	1.35	0.74	2.59	1.39	311.7	4,953,473
Physical therapists	2.86	2.85	6.77	2.12	346.8	3,529,518
Therapists, n.e.c.	1.69	0.61	6.69	3.46	315.3	2,507,109
Speech therapists	3.06	0.73	3.18	4.60	327.5	2,418,274
Occupational therapists	5.01	1.53	9.21	4.13	349.4	1,543,331
Authors	0.68	1.31	13.65	18.26	336.9	1,374,235
Veterinarians	2.35	1.63	3.64	2.04	350.3	804,724
Actuaries	1.77	1.38	3.69	1.57	351.5	719,161
Dancers	1.71	1.96	5.90	5.25	294.9	570,139
Mech. engineering techs.	2.36	0.79	0.67	6.97	335.5	498,008
Medical science teachers	0.83	4.93	2.26	1.62	360.1	337,516

Notes:
[a] Wage and hours change figures are annual percentage changes. Our criterion for "large" is >= .5%.
[b] Average hours worked per week.

growth. The largest, ranked by size, were Supervisors and Proprietors, Sales Occupations, Registered Nurses, Managers (Manufacturing), and Accountants. While these are no doubt relatively high-skill jobs, they are not particularly associated with technological change. Two of the five fit Gordon's "bureaucrats" who contribute to the supervisory burden. But, again, these are relatively *low* wage growth occupations in this recent period.

The conclusions from the scatterplots are reflected in the weighted regression estimates presented in Panel D of Table 2.3. Separate tests by gender also produce no evidence of a positive relationship between wage and hours change.

The lack of a clear relationship between employment and wage growth is also evident in Figures 2.9 and 2.10, which show relative wage growth

Figure 2.9 **Wage Growth by Hours Growth Decile, 1984–1992**

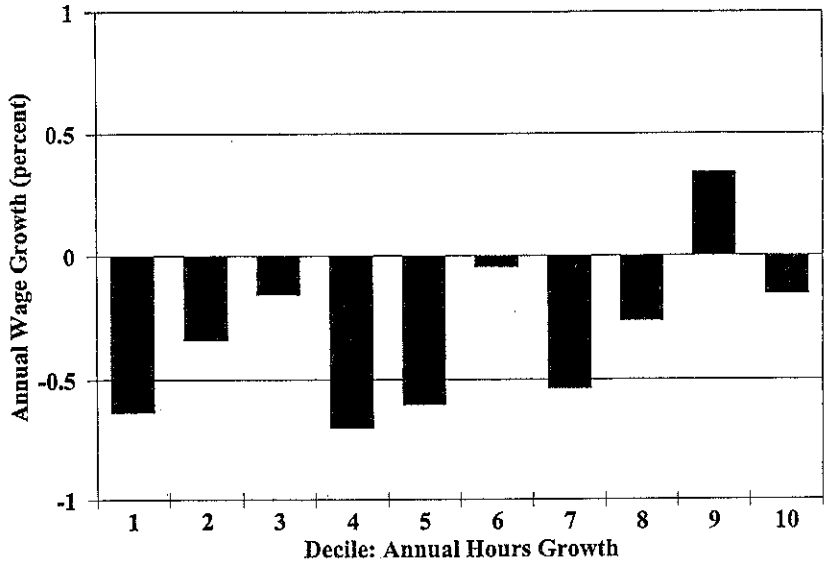
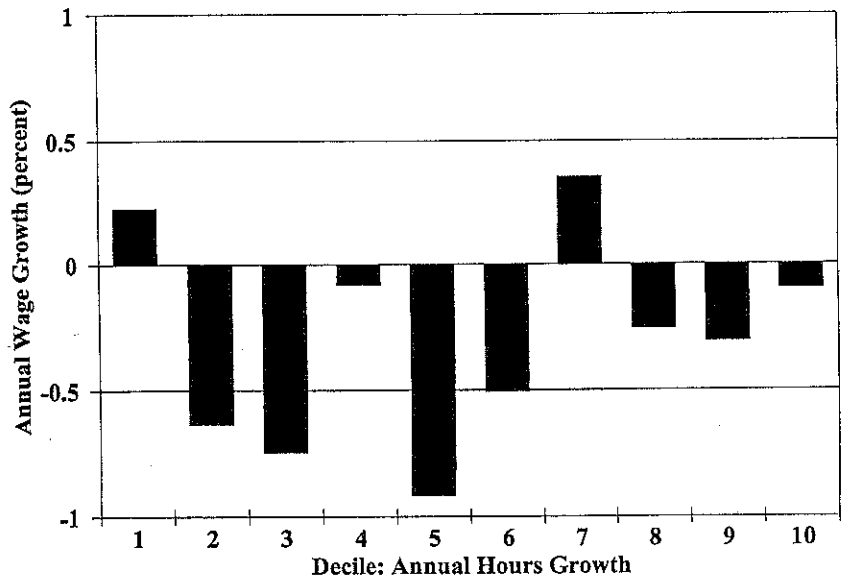


Figure 2.10 **Wage Growth by Hours Growth Decile, 1989–1997**



by deciles of employment growth, again measured by growth in relative hours. In the 1984–92 period, the largest relative wage declines were experienced by workers in the first, fourth, and fifth deciles; the ninth decile was the only one showing positive average wage gains. In the later period, the first and seventh decile had positive wage growth. But there is no apparent pattern to the bars: wage growth shows no systematic link to hours growth across disaggregated occupations.

Wage Change and Skill Levels

The single variable equations presented above account for hardly any of the variation in relative wage change. It may be that with a more adequate specification, hours growth would show the expected positive relationship with wage growth. Numerous studies have documented a rising return to skill, as measured by years of schooling. While the explanation remains controversial, it is clear that higher-skilled occupations have experienced higher wage growth (Gittleman 1994; Pryor and Schaffer 1997). But has this relationship strengthened, as we would expect if skill-biased demand shifts have been the main source of growing wage inequality? Here we consider in more detail the role of skill in the wage and hours dynamics analyzed above. We focus mainly on the NALS score, the average of three indices of workplace literacy—prose literacy, document literacy, and quantitative literacy—from the National Adult Literacy Survey. We use only the most disaggregated breakdown of occupations, the three-digit and modified three-digit levels.

Table 2.5 presents results of simple OLS tests that relate wage growth to hours growth and skill levels, the latter measured by the share of workers in a job with greater than a high school degree, by the DOT Factor 1 measure and by the average functional literacy of workers employed in each occupation (NALS). In every test reported here, the skill measure is positively and significantly related to wage change across jobs. While hours growth alone accounted for virtually none of the variation in wage growth in Table 2.3 (R^2 less than 1 percent), the addition of skill measures in Table 2.5 results in equations that account (with one exception) for 3–29 percent of the variation in wage growth across detailed occupations.

Note, however, that the association between wage growth and the skill level of occupations declines noticeably from the 1980s (1984–92) to the 1990s (1989–97) for both men and women. The regression coefficients on the skill variables and the coefficient of variation for the

Table 2.5

Regression Results: Effects of Skill on Wage Growth

	Greater-than-high-school		"Factor 1"		NALS score	
	Hours growth	%>HS	Hours growth	Factor 1	Hours growth	NALS
Panel A: 1984–92						
Total	–0.01	1.70***	0.01	0.24***	–0.0002	0.011***
(N=392)	(0.01)	(0.17)	(0.01)	(0.05)	(0.01)	(0.001)
	Adj. R^2	0.217	Adj. R^2	0.055	Adj. R^2	0.139
Males	–0.02**	1.38***	0.00	0.36***	–0.01	0.010***
(N=358)	(0.01)	(0.15)	(0.01)	(0.05)	(0.01)	(0.001)
	Adj. R^2	0.181	Adj. R^2	0.122	Adj. R^2	0.133
Females	–0.01	2.11***	–0.003	0.45***	–0.01	0.014***
(N=258)	(0.01)	(0.21)	(0.01)	(0.07)	(0.01)	(0.001)
	Adj. R^2	0.291	Adj. R^2	0.151	Adj. R^2	0.181
Panel B: 1989–97						
Total	–0.03***	0.95***	–0.02	0.12***	–0.03	0.007***
(N=392)	(0.01)	(0.16)	(0.01)	(0.05)	(0.01)	(0.001)
	Adj. R^2	0.083	Adj. R^2	0.013	Adj. R^2	0.059
Males	–0.02	0.97***	–0.01	0.21***	–0.02	0.008***
(N=358)	0.01	(0.18)	(0.01)	(0.06)	(0.01)	(0.001)
	Adj. R^2	0.071	Adj. R^2	0.033	Adj. R^2	0.061
Females	–0.03***	0.90***	–0.02	0.19***	–0.02	0.006***
(N=258)	0.01	(0.19)	(0.01)	(0.06)	(0.01)	(0.001)
	Adj. R^2	0.082	Adj. R^2	0.044	Adj. R^2	0.055

Notes: *** indicates significance at 1 percent level, ** at 5 percent, and * at 10 percent.

equation all decline markedly between these two periods for each of the eight tests presented. For all workers with NALS as the skill measure, the coefficient drops from .011 to .007, with a decline in the R^2 from 14 to 6 percent. The magnitude of the decline for male workers is similar, and much larger for female workers. If computerization and globalization are the main sources of a demand shift we would have expected the reverse to hold, since both developments have characterized the 1990s at least as much as (and probably more than) the 1980s, and because it takes time for firms to adjust to structural changes of this sort.

Within the supply/demand model, demand shifts may be manifested in a variety of combinations of hours and wage change depending upon the elasticity of supply. If demand shifts are as skill-biased as the literature claims, then there should be a strong statistical relationship be-

tween occupation skill levels and the sum of hours and wage change. We present the results of this exercise in Figures 2.11 and 2.12 for 448 modified three-digit occupations. The trendline is upward sloping, as predicted. But the slope is modest, with the NALS measure accounting for 6.5 percent of the variation in hours + wage change in the first period, and 5.8 percent in the second. In sum, if this is a measure of the demand shift, we find a modestly positive statistical association of skill levels with it, but no evidence of strengthening over time.

The conventional view on the positive correlation between employment and wage growth finds weak and, over time, weakening support at the level of detailed occupations. And yet skill level is clearly and positively associated with both wage and hours growth, patterns that are consistent with the conventional view. How can we reconcile these patterns? The answer must be that some high-skill occupations are experiencing relatively rapid growth in hours and some are enjoying relatively large wage increases, but fewer occupations are experiencing both. For example, we find that many managerial and service occupations show high relative hours growth but low relative wage growth. In addition to Retail Managers, which made the list just described, supervisory jobs located in the southeast quadrant in the 1990s include Managers, Medicine and Health; Securities and Financial Services Sales; Administration and Official, Public Administration; Managers, Education and Social Services; Managers, Transportation; and Managers, Related Occupations, n.e.c. These are high-skill jobs as measured by NALS, but have been experiencing declining relative wages. Once again, we find little support at the detailed occupation level for either the skill mismatch or the supervisory burden explanations.

Employment and Wage Growth, 1970–94

As a check for the robustness of the results reported above and to better assess the change in the association between wage change, employment growth, and skill levels over time, we conducted similar analyses with data from the March Current Population Survey (CPS). In these tests we employ an alternative measure of the hourly wage. We also use a measure of employment (rather than hours) for different years covering a longer time span (1970, 1979, 1986, and 1994).

Although our measure of earnings remains the hourly wage and it is derived from the same underlying source (the CPS), it is constructed

Figure 2.11 **Wage Plus Hours Change versus NALS Score, 1984–1992**

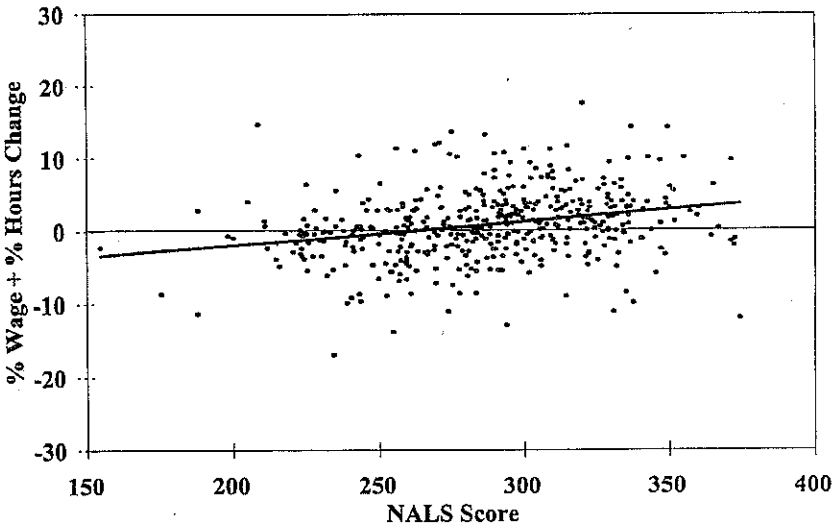
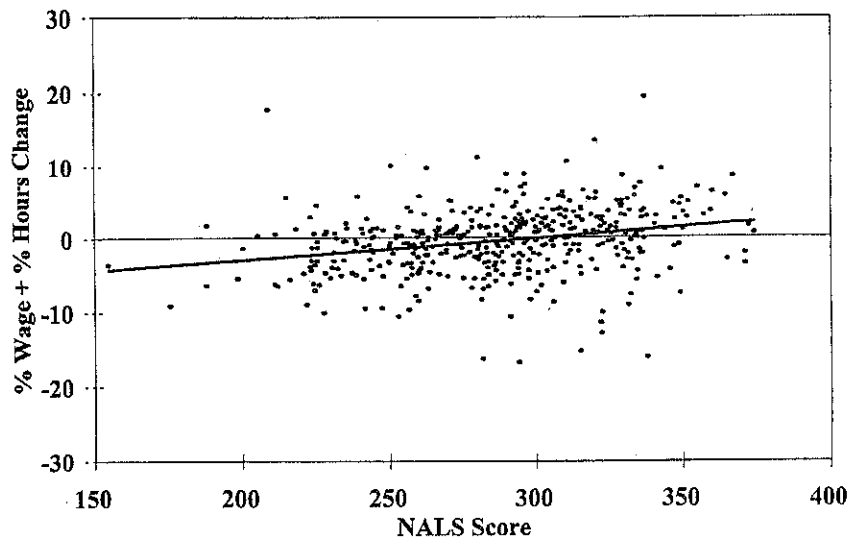


Figure 2.12 **Wage Plus Hours Change versus NALS Score, 1989–1997**



differently. The results presented above were based on the CPS Outgoing Rotation Groups (ORG) data, in which the hourly wage is taken directly from survey respondents if they were paid by the hour; for salaried workers, the hourly wage was derived from weekly earnings in the previous week (adjusted by usual hours per week). On the other hand, in the March CPS data used here, the hourly wage must be derived from estimates by respondents of their annual earnings in the previous year, which can then be adjusted to an hourly figure using usual weeks and hours per week. Bernstein and Mishel (1997) argue that the hourly wage estimates from the ORG data are superior. Nevertheless, these March CPS data are widely used in earnings studies and their availability in a form that allows for comparison before and after the substantial changes in occupation definitions in the 1980 Census offer us an opportunity to check the robustness of the results presented above over a much longer time period. Excluding the smallest occupations, 441 occupations are included in the first two periods (1970–79 and 1979–86) and 447 in the most recent period (1986–94).

Results for the simple weighted regression of percentage wage change on percentage employment change and skill level (the overall NALS score) for the three subperiods are presented in Table 2.6. Like most of the coefficients on hours growth in Table 2.5, the top row shows that in the first two periods (1970–79 and 1979–86), employment growth was negatively or only weakly positively related to wage change, whether or not the NALS skill measure was included. Consistent with the skill-biased demand shift account, the coefficient on NALS is far higher in the 1980s and 1990s than in the 1970s. But only in the most recent period do we find the predicted statistically significant positive relationship between employment and wage change. And even here, in the 1986–94 period, when computerization should have had its greatest impact on the wage structure, the explanatory power of our simple skill-biased demand shift model of wage change is negligible. Only a tiny share (1–2 percent) of the variation in wage change across these 447 occupations is accounted for by our measures of employment change and skill levels, even less than for the results shown in Table 2.5 for 1989–97.

For 1970–79, neither employment growth nor skill level helps to explain wage change. The problem is that in the 1970s we count 186 occupations with relatively high employment growth but low wage growth. In 1979, these occupations accounted for 43 percent of total employment. Equally notable, these low wage growth jobs had the same average score on functional literacy (292) as the 73 occupations that experienced relatively high growth in hours and wages.

Table 2.6

Regression Results: Wage Change on Hours Change and Skill Level
(Pryor/Schaffer 3-digit occupations)

	Period 1: 1970–1979 (N=441)		Period 2: 1979–1986 (N=441)		Period 3: 1986–1994 (N=447)	
Variable coefficient (standard error)	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Employment growth	–0.047** (–0.02)	–0.052** (–0.02)	0.002 (0.003)	–0.0013 (0.003)	0.068*** (0.028)	0.053* (0.028)
NALS		0.002 (0.002)		0.0114*** (0.0025)		0.0095*** (0.0036)
Adjusted R^2	0.011	0.010	0.001	0.047	0.011	0.024

Notes: * indicates coefficient significant at the 10 percent level, ** at 5 percent; *** at 1 percent.

Regressions are weighted by total occupational employment in the last year of each period.

For the 1979–86 period, the functional literacy score in high wage and employment growth jobs is substantially higher (304) than the scores for jobs in the other three quadrants (280–85), consistent with the conventional view. Still, over half of all workers were employed in occupations that appear "off the diagonal"—that is, in the northwest and southeast quadrants in Figure 2.2. The results in the middle panel of Table 2.6 indicate that there was a positive association between wage change and skill levels, but not between wage change and employment growth, in the early- to mid-1980s; the coefficient on employment change is small and insignificant in both models. The addition of the NALS skill measure increases the explanatory power of the equation from zero to almost five percent. While this improvement is substantial, these models, like those presented in Table 2.5, appear to provide scant support for the skill-biased demand shift hypothesis.

For the most recent 1986–94 period, both employment change and skill level measures are positive and statistically significant, but (as noted above) the explanatory power of the equations is minimal. Again, be-

hind this poor performance are jobs that are located in the off-diagonal quadrants. The scatter plots of employment growth and the March CPS hourly wage look similar to those that appear in Figures 2.5 through 2.8 (which, again, relied on hours growth and a more direct measure of hourly wages with different years as end points). The average functional literacy (NALS) scores in the occupations experiencing relatively high wage growth and slow employment growth (the northeast quadrant) and for occupations experiencing slow wage growth and relatively large hours growth (the southeast quadrant) are nearly the same as the mean NALS scores for occupations with relatively high hours and wage growth (the northeast quadrant): 287 and 292 compared to 299.

As we found with the ORG data, the monthly CPS data indicate that a large share of the workforce, ranging from 28 to 40 percent, is employed in occupations that show strong employment growth but declining relative wages. In the 1986–94 period, the largest of these were Supervisors and Proprietors, Sales Occupations; Truck Drivers; Janitors and Cleaners; Nursing Aides, Orderlies and Attendants; Cooks; and Stock Handlers and Baggers. The poor wage performance of these service sector jobs is unlikely to be much affected by foreign trade or the outsourcing of production to low-wage foreign countries. On the other hand, if technological change (computerization) accounts for the slow wage growth of these high employment growth jobs, it may be due to *deskilling*, which has the effect of increasing the supply of workers available to firms—a very different skill-biased technological change explanation for recent relative wage trends.

V. Conclusion

Earnings inequality increased substantially between the late 1970s and the late 1990s. It is widely accepted that the rising gap between the best and worst paid workers reflects a growing payoff to skill as the workplace is transformed by computerization and the competitive pressures of globalization. In this view, the "best" jobs have grown fastest, leading to rapid wage increases as employers try to fill positions, while declining demand for the worst jobs has led to collapsing wages, as too many low-skill workers chase too few jobs. If this skill-biased demand shift explanation can account for much of the growth in inequality, we should observe a fairly tight statistical fit between changes in employment and changes in wages: the highest (lowest) skill jobs should show

both the highest (lowest) hours/employment growth and the highest (lowest) wage growth. The strength of this fit should improve with our ability to measure the skill of a job. This requires both a good measure of skill and narrowly defined (homogeneous in skill) job classifications. And finally, as both computerization and globalization advance, in the absence of substantial compensating supply shifts, skill-biased demand shifts should produce a strengthening of the association between skill requirements, employment growth, and wage growth across jobs over time.

On balance, at the occupation level the skill-biased demand shift explanation is not strongly supported by our results, which can be summed up in three main points. First, consistent with the conventional wisdom, jobs that have experienced both high (low) wage and high (low) hours growth tend to show, *as a group*, the highest (lowest) skill levels. However, for detailed occupations we can generalize only about the *low* wage and hours growth occupations, which for both male and female workers clearly require the least skills, at least as conventionally measured. Outside of this "southwest quadrant," the picture is much less clear. *For both males and females, high wage and hours growth occupations reflect a mix of low, middle, and high skill requirements.* Indeed, by far the most hours worked in the high wage and employment growth jobs through the mid-1990s have been by education and health service sector professionals. These are jobs whose credentialing (medical licensing, advanced degrees, teaching certificates) typically shelters them from the virulent wage competition that has afflicted much of the workforce. This finding is not strongly supportive of either the conventional computer-driven demand shift story or Gordon's bureaucratic burden account.

Our second finding further complicates the story. Workers are by no means limited or even concentrated in these two conventional categories—the high skilled jobs with high wage and hours growth and the low skilled jobs with low or declining wage and hours growth. Rather, we find that *a large share of total hours worked (and employment) occurs in jobs with relatively high hours growth but low wage growth (the southeast quadrant).* Together with the range of skill levels required in the high wage and employment growth jobs, this "off-diagonal" result explains our failure to find any statistical relationship between wage change and hours change across occupations.

Interestingly, the relationship between hours and wage change appears to depend on the level of occupational aggregation, but in a way that is just the reverse of what we would have expected. That is, we find

a modest positive statistical relationship between relative wage growth and relative hours growth at the most aggregated classification level (thirteen one-digit large occupation groups), even less at the two-digit (forty-four occupation groups), and none at the three-digit (390 occupations) and modified three-digit (450 occupation/industry cells) levels. This result holds for each time period, for both data sets, and for both male and female workers.

Our third principal finding relates to the link between wage change and skill. If skill-biased technological change (computerization) and competitive pressures from globalization and deregulation account for a demand shift against low-skill workers, we would expect the wage change/skill relationship to strengthen over time. We find no evidence that this has occurred. If anything, we find a weakening of this relationship for total, male, and female workers. Nor do we find that the relationship between the sum of hours and wage change (a possible measure of demand shift) and skill levels is either particularly strong (about 6 percent of the variation in this sum) or growing stronger. Like our previous finding, a modest relationship in the 1980s appears no stronger in the 1990s.

Together, these results appear to offer little support for either the skill-biased demand shift or the supervisory burden accounts of the growth in U.S. earnings inequality. But while higher-level private sector managers do not seem to account for the widening wage gap, we do find some provisional support for Gordon's "low-road" hypothesis. Occupation hours and earnings trends do suggest that institutional changes—the declining value of the minimum wage, declining union density and power, and rising shares of irregular (contingent) employment—have been pivotal in the wage collapse experienced by many non-supervisory workers.

We find that low-skilled blue-collar jobs in goods producing industries appear to have played a major role in the earnings collapse; these jobs are heavily concentrated in the low wage and employment growth quadrant. We suspect that trade and outsourcing patterns, de-unionization and deregulation have all played substantial roles in the declining wages and employment of workers in this part of the job structure. On the other hand, many low-skill blue-collar jobs in the service industries show high hours growth but have experienced relatively slow wage growth, suggesting a combination of supply-side (immigration) and institutional (declining value of the minimum wage in the 1980s) factors. We find some middle level office worker jobs located in the slow hours

growth but relatively high wage growth jobs, a result that may be explained in part by computerization and, after 1989, by increases in the minimum wage. While a variety of jobs have been characterized by both high wage and high hours growth over the last two decades, education and health sector professionals dominate, particularly when measured by total hours worked.

Our portrait, then, is not supportive of simple explanations. But it is consistent with the view that the undermining of traditional labor market institutions has exposed non-supervisory workers to more virulent wage competition, while at the same time many of those that have done relatively well have been skilled professionals (particularly teachers, physicians, and related health professionals) who are often sheltered from wage competition by labor market institutions that have remained in place: credentials, licenses, and protective internal labor markets. The dominance of the simple textbook model almost certainly biases economists toward simple demand/supply explanations of wages. But as Gordon argued, important changes in relative earnings reflect shifts in the balance of power between workers and employers, and this power can stem at least as much from labor market institutions, public policy choices, and management strategy as from shifts in labor demand and supply. The trends we have reported support this more complex view.

The critical research task that remains is to better disentangle the roles of demand, supply, and institutional factors in the explanation of labor market outcomes at the detailed occupation level. More specifically, we need to do a better job of measuring the effects of the institutional shifts caused by management's offensive against labor—what Gordon termed the "low-road" hypothesis—on earnings inequality. Which non-supervisory jobs have been strongly impacted by computerization, de-unionization, deregulation, outsourcing, trade patterns, changes in the value of the minimum wage, and immigration? Further progress on this front would surely have been at the top of David Gordon's research agenda had he had the opportunity.

Notes

This is a revised version of Howell et al. (1999), a report to the Rockefeller Foundation, printed with permission from the Center for Economic Policy Analysis. We thank Maury Gittleman, Michel Juillard, Jared Bernstein, John Schmitt, and Larry Mishel for their comments and advice and Fred Pryor for sharing data with us. We also thank Friedrich Huebler, Margaret Duncan, and Josh Bivens for their research

assistance. This work began under a project funded by the MacArthur Foundation and we thank both the Rockefeller and MacArthur foundations for their generous support.

1. Earnings of the typical ninetieth percentile (high wage) male worker were 4.49 times higher than that of the tenth percentile worker in 1979. This figure rose to 5.31 in 1989 and 5.66 in 1996, reflecting mainly a real wage collapse for those at the bottom of the wage distribution. But even those in the middle of the distribution have done poorly in absolute terms: the real earnings of the median (fiftieth percentile) male worker fell steadily from $14.50 in 1979 to $12.62 in 1996. Among women, the trend has been similar but inequality levels have been lower (3.64 in 1979, 4.74 in 1989, and 5.1 in 1996) and, significantly, this increase has stemmed largely from gains at the top of the distribution (Bernstein and Mishel 1997, table 6).

2. It should be noted, however, that the measurement of changes in relative supplies of skill is problematic, due both to the problem of measurement of skill and the difficulty of identifying the relevant labor market; new transportation and communications technologies have facilitated a speedup in the globalization of production, dramatically increasing the effective supply of low-skill labor (Rodrik 1997; Howell 1997, 1999).

3. Gordon's approach in *Fat and Mean* follows closely his earlier macroeconomic work on the social model for productivity growth (Weisskopf, Bowles, and Gordon 1983).

4. The power of supervisors in the wage squeeze process rises as the corporate ladder is ascended. In a hierarchical and adversarial labor relations system, "you need supervisors to supervise the supervisors . . . and higher-level managers to watch the lower-level managers. A pyramid takes shape in which every level of supervision from the bottom on up is essential to the operations of the entire enterprise" (Gordon 1996, 40).

5. Some work in this direction has been carried out by Howell (1995), Howell and Wieler (1998), and Carnevale and Rose (1998).

6. According to Freeman and Katz (1994), "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." Similarly, Bound and Johnson (1995) write, "Our suspicion is that a secular shift in production functions in favor of workers with relatively high intellectual as opposed to manual ability—a process that accelerated during the 1980s because of computers—is responsible, in concert with the slowdown of the growth in the relative supply of skilled labor, for most of the wage phenomena that have been observed."

7. Demand shifts strongly biased toward the most skilled that dominated supply shifts will produce both higher wages and higher employment levels for skilled compared to less skilled workers. The exception is in the case of perfectly inelastic demand curves, under which only wage changes favoring the most skilled will be observed.

8. The data for this longer term analysis were generously provided by Frederick Pryor and David Schaffer. These data are the basis for much of the empirical work presented in Pryor and Schaffer (1997). They use a five-stage iteration program developed at the Bureau of Labor Statistics to adjust the allocation of individuals to occupations to reflect the 1970–80 occupation revisions. We received mean hourly wages and employment for three-digit occupations for both total and prime age workers for the four years cited in the text. The obvious disadvantage is that we are limited to the wage and employment measures created by another project.

9. We thank Maury Gittleman for providing the factor scores for the 1980 Census occupation classifications.

10. Personal correspondence with Patricia Simpson, Institute of Human Resources and Industrial Relations, Loyola University.

11. The NALS scores were downloaded from the National Center for Education Statistics http://nces.ed.gov/NADLITS/data.html.

12. We will explore the reasons for this upward trend in within-occupation variation in a forthcoming paper.

13. The Census defines 501 three-digit occupations. We omitted 102 because of small numbers of observations. Only occupations with at least ten observations in both periods were retained. Six large three-digit occupations are subdivided by industry to create the "modified three-digit" set of occupations.

14. Estimates using unweighted occupation groups generated similar results and, while not reported here, are available from the authors on request.

15. Jobs with very small numbers of workers in the sample were excluded. But because the excluded occupations are so small there is little loss in coverage. For example, at the one-digit level we count 3,852 million hours worked in 1992, which compares to 3,848 million hours worked in the same year in our 392 three-digit occupations—a loss of just 4 million hours, or just .01 percent of the total.

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