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THE TIMING OF WORK TIME OVER TIME

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ABSTRACT

The incidence of evening and night work declined sharply in the United States between the early 1970s and the early 1990s, while the fraction of work performed at the fringes of the traditional regular working day grew. The secular decline in evening and night work did not result from industrial shifts or demographic changes. It was greatest at the upper end of the wage distribution, slowest among workers in the lowest quartile of wages. The observed changes in timing are consistent with and magnify the increase in wage inequality in the U.S. that occurred during this period. They are easily explained by a model that views evening/night work as a disamenity, with rising real incomes causing workers to shift away from such work in the presence of only neutral technical change in the profitability of work at different times of day.

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> The subject's position in space can be elected, but his position in time cannot be elected. For the subject, the living individual, there is but one moment -- the present. (Shackle, 1961, p. 42)

I. The Nature of the Problem

The study of time use in all its dimensions -- the amount of labor supplied by an individual over some period of time; participation in the labor market; the use of time outside the labor market -- has among all issues related to the behavior of workers attracted the greatest attention from economists. One aspect of time use, the timing of people's work effort during the day, has received remarkably little attention from economists, but a bit more from other social scientists.[1] Studying the instantaneous use of time, as opposed to time use integrated over days, weeks, years or a working life, can yield insights into questions about behavior that are not obtainable from examining other labor-market outcomes. In what follows I deal with one aspect of instantaneous time use, namely how it has changed in the United States since the early 1970s, and examine how those changes can be useful in understanding other labor-market developments. The several new facts that are discovered are amenable to explanation by a simple economic theory of the timing of work.

Studying the timing of work is interesting not just because of the light it might shed on other economic issues. Knowledge about the timing of work itself can be directly informative about labor markets. Most of the interest arises because, unlike many other aspects of work, timing is inherent in work: Effort is made during certain parts of the day or week, and the timing of that effort affects workers' well-being and firms' profitability. As an example, consider the issue of the extent to which a society is integrated. One way of measuring integration is to record the possibility that its members can interact with each other. If, for example, people engage in work at different times of the day, the opportunities for social interaction are reduced. Obversely, if people work at the same times of day,

they have the opportunity of enjoying each other's company then and during the remainder of the day when they are at leisure. One might argue that a society in which workers do not have chances for schmoozing, both while at work (Hamermesh, 1990) and while at leisure, is a poorer society.[2]

Even more important, the timing of work is an outcome that is part of the overall package of rewards that people obtain from their work. How timing differs across individuals, and how it changes over time, should affect our perceptions of workers' well-being. Thus examining this issue should also be viewed as part of the study of the distribution of economic welfare.

In the next section I present as a theoretical motivation one approach to the study of the timing of work, with the purpose of providing a framework to consider the evidence that forms the remainder of the study. Section III discusses the data from the United States between 1973 and 1991 that underlie the empirical analysis. Section IV examines the pattern of work timing at the aggregate level during this period and discusses its proximate causes, Section V analyzes the distribution of work time and its relation to changes in economic inequality, and Section VI interprets the evidence in light of the underlying framework.

II. A Theoretical Motivation

There are no doubt numerous approaches that one could take to explain the timing of work over the day and week. One recent attempt (Weiss, 1996) essentially views the timing of work as the result of an equilibration process that maximizes the gains that can be obtained from the jointness of production using various combinations of workers at various times. This approach accounts for behavior by both workers and firms and has the virtue of explaining why agglomeration of people's work timing exists. Rather than concentrating on jointness in the timing of work, however, I focus here instead on the choice of work times as an issue in the assignment of amenities -- the matching

of workers with heterogeneous tastes for work times with firms that have different costs of offering work at various times of the day. This approach ignores the subtle issues of economies of agglomeration in the timing of production and of the fixed costs that are generated when a worker moves into or out of work. Viewing the determination of the timing of work as an amenity does, however, allow us to draw some very clear and potentially useful predictions that would not be so readily obtainable from another approach.

The worker's choice of timing has been presented completely by Winston (1982). Let a particular time of day be denoted by t (t = 1,...,24). Then the worker/consumer's problem is to maximize:

$$(1) \qquad V_i = \sum_t U_{it}(1-L_t, C_t) ,$$

$$\text{subject to } \sum_t \{w_{it}L_t - C_t\} = 0 ,$$

where L is an indicator equalling 1 if person i works at time t, 0 if not; w is the wage rate person i can obtain by working at time t, and C is the amount consumed at t. Time t denotes small discrete intervals (hours), small enough that I assume that the person does not consume while at work. I also ignore discounting, since we are summing only over a one-day period. Assuming that the price of the consumption good is one, worker i's maximization in this set-up simply involves working at all times t when $-\Delta U_{it}/\Delta L_t / \Delta U_{it}/\Delta C_t \leq w_{it}$. This view treats the choice of whether to work at time t analogously to the standard analysis of the zero-one choice of labor-force participation, except that here the choice is whether or not to work at some particular hour, not whether or not to be in the labor force at all. The term $-\Delta U_{it}/\Delta L_t / \Delta U_{it}/\Delta C_t$ can be viewed as the shadow value of worker i's time

at hour t. These prices presumably differ over the hours t in the day and differ among workers i at each t.

The nature of firms' willingness to offer work at different times of the day has not been examined in the context of a model that treats timing as an amenity. We can view employers as being differentially able to generate profits by producing at various times of the day. Firm j's profit function is thus:

(2) $\Pi_j = \Pi_j(a_{j1}N_1,\ldots,a_{j24}N_{24})$,

where N_t is the number of workers employed at time t, and a_{jt} is the contribution of a worker at time t to firm j's profits. Along with differences in the Π_j , variations in the pattern of the a_{jt} across firms will generate heterogeneity in firms' offers of work at different times. Technical change will alter profit functions generally and cause different firms to become relatively more productive than others at different times of the day; but it can also change the pattern of the a_t within a particular firm, leading the firm to alter how it structures the timing of work over the day.

Equilibrium is characterized by the assignment of workers to firms, as is standard in models of implicit markets (Rosen, 1986). In this case the market bundles offers of work with the necessity that they are linked to workers being on the job at particular times of day. Workers whose reservation wage at time t is lowest will be found working then in firms at which the a_{jt} are highest, other things equal. Depending upon the distributions of reservation wages across individuals and over all times t, and on the distributions of the a_{jt}, the market will generate a pattern of equilibrium wage differentials θ_t, so that each worker faces a vector of wages $w_{it} = w_i[1 + \theta_t]$, where w_i is the worker's wage rate at an arbitrarily t chosen so that $\theta_t = 0$. Presumably there are some t' that are viewed as undesirable (as disamenities) by relatively more workers than would be required to fill

employers' labor demands at those t' if $\theta_{t'}$ were 0. At those times $\theta_{t'} > 0$, and workers with lower full earnings will be more likely to be at work than otherwise identical workers. Obversely, at the t" which are more desirable (relatively) we will see $\theta_{t''} < 0$ and observe workers with higher full incomes comprising a disproportionately large fraction of the employees working at those times.

All of this assumes that the market generates the θ_t. Of course, this may not be true in unionized plants in the United States, and nonmarket wage-setting of the premia for work at different times t may spill over to the nonunion sector.[3] The evidence (for examples, Kostiuk, 1990; Shapiro, 1995) suggests that, at least for those t' defined as times of shift work, the actual premia are not very large. (Whether or not they are below the equilibrium $\theta_{t'}$ is not clear.) Depending on the preferences represented by the union, the artifical restrictions may alter the variance of the observed premia/penalties compared to the equilibrium $\theta_{t'}$ and change the impacts of differences in full income on the distribution of the timing of work.

If the technology of the timing of work has exhibited only neutral (proportional across times of the day) changes, this approach gives clear predictions relating variations in timing over time to other labor-market outcomes. Assume that we can identify those times of the day that workers find relatively less desirable (for which the equilibrium $\theta_t > 0$). Then under our assumption about technology, if the average worker's full earnings have been rising, we should find a declining amount of the total work performed economy-wide at those inferior t. Obversely, since workers choose to "spend" some of their full earnings on amenities, if we find such a decline, we can infer that the average worker's real wage has been increasing.

Under the maintained assumption of temporally neutral technical change we can also relate changes in wage inequality to changes in the distribution of timing by wage level. For any amenity

A, such as work at those times t when $\theta_t < 0$ (given a constant total hours worked), we can write worker i's "spending" on wages and A as:

(3a) $w_{is} = a + bE_{is}$, and:

(3b) $A_{is} = c + dE_{is}$,

where a, b, c, d are positive constants, and E_{is} is worker i's full earnings at some point in time, call it year s. Then the variances across workers in wages and the distribution of the amenities in year s are related by:

(4) $\text{Var } A_s = [d^2/ b^2]\text{Var } w_s$.

Thus we should expect the distribution of the amenities to widen (narrow) over time if the distribution of wages is widening (narrowing) with s. In particular, if the distribution of wages is widening we should see relative increases in the fraction of work at inferior times performed by lower-wage workers, and relative increases in the fraction of work performed at superior times by higher-wage workers.

Implicit in this discussion is the assumption that the technology of timing remains constant or changes neutrally across hours of the day. There is no particular reason to maintain that assumption; but unlike the derivation of the implications in (4) that stem from workers' behavior, it is difficult to discover correlates of nonneutral technical changes in work timing. Despite that difficulty, in Section VI I make some effort to determine whether the technology of work timing changed during the period under study.

III. Data and Construction of the Measures of Timing

There is remarkably little data on the timing of work over the day, and, unsurprisingly, remarkably little empirical research has been done on this issue. Some attention has been given to

the extent of shift work in manufacturing. Aside from the relative unimportance of manufacturing in most modern economies, there are real difficulties in equating shift work and the timing of work over the day. For example, of the 13 percent of workers who performed some of their work between 10PM and 6AM in 1991, 4 percent called themselves regular day-shift workers; and only 3 percent referred to themselves as regular night-shift workers. Similarly, of the 17 percent who performed some work between 7PM and 10PM, 5.5 percent were regular day-shift workers, and only 5.4 percent called themselves regular evening-shift workers.[4] To understand the distribution of the timing of work we need to go beyond categorizing workers by shift.

The best (and really the only broad-coverage) data from which information on the timing of work can be constructed for the United States are in several of the May Multiple Jobholding supplements to the Current Population Survey. From 1973-1978, and again in 1985 and 1991, respondents to the May CPS were asked about the usual starting and ending times of their regular jobs. Using this information I construct the series L_{it} for each worker in the CPS for each year s = 1973, 1978, 1985, 1991. To be included in the sample used in most of this study the person must usually work at least 20 hours a week, must not be self-employed and must be paid for his/her work. This nearly twenty-year view of the distribution and changing timing of work should be sufficiently long to allow one to infer the existence of any trends in the averages of the L_t.

In order to separate economic from other factors that might affect the trend and distribution of timing I also form a number of standard demographic variables from the CPS. These include whether the worker is black and/or Hispanic; the worker's education and experience (calculated from schooling and age); whether the person has children under age 18 in the household; whether the person is in the "Rust Belt" (states in the New England, mid-Atlantic and East North Central regions)

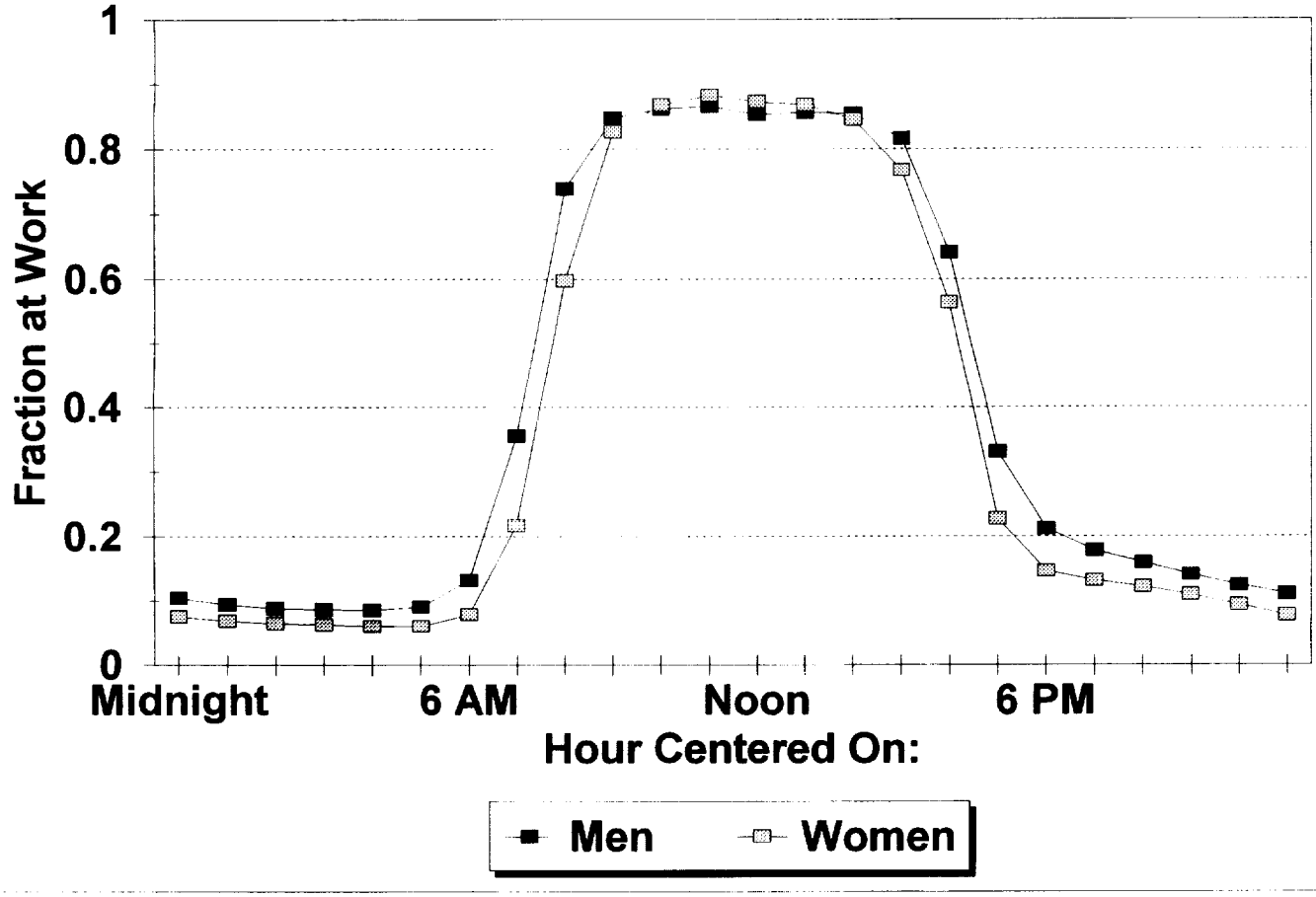
and the worker's industry.[5] Since the BLS definitions changed over this time period, it is necessary to aggregate three- and four-digit industries to obtain a set of industry definitions that is consistent over the two decades. This resulted in the creation of 58 mostly two-digit industries that are defined identically over this period. Finally, to examine the hypothesis implied by (4) I rely on the worker's reported weekly earnings (although recalculating the results using computed hourly earnings produced no qualitative differences).[6]

IV. Patterns of Aggregate Changes in Work Timing

Before examining how patterns of timing have changed and the determinants of any changes it is useful to understand how diverse the patterns actually are, since even these have not heretofore been analyzed in the literature. Figure 1 presents for 1973 the fraction of male and female paid employees who were at work at each hour of the day. The most striking fact from the figure is the diversity of schedules: Even at the peak work times (9AM through 3PM inclusive) well below 90 percent of all workers who put in at least 20 hours per week reported being on the job. Obversely, even at the least heavily worked times of the day (1AM through 5AM) in 1973 nearly 10 percent of male workers were at work. Also, unsurprisingly (since their total work hours are fewer) at almost all hours of the day a smaller fraction of female than of male workers were on the job.

To describe the changes in timing since 1973 we need to account for changes in average daily hours of work: As should be obvious, and as the female-male comparison in Figure 1 implies, workers in any group that averages longer daily hours are more likely to be observed working at any particular hour of the day. To account for the changes in reported average daily hours from 1973 to the years when the other three May CPS samples were taken, s = 1978, 1985, 1991, I regress L_{its} on the worker's total scheduled hours separately for male and female workers. The mean probability

Figure 1. Fraction at Work, 1973, Men and Women



of work at each year s is then used to produce L^a_{ts}, which measures the mean fraction of workers at work at time t in year s, adjusted for changes in average total work hours over these four years.[7]

The differences between the L^a_{ts} for s = 1978, 1985, 1991, and $L_{t,1973}$ are shown for each hour t in Figure 2a and 2b for male and female workers respectively. Because the means are standardized to total daily hours in 1973, the integrals of these differences are identically zero for each year s. Also shown in each Figure (the lightest lines) is a $\pm 2\sigma$ range around the null hypothesis that the difference $[L^a_{ts} - L_{t,1973}] = 0$. Two distinct trends are apparent in the Figures. First, and most important, there has been a significant diminution in the amount of work performed between 7PM and 5AM inclusive: Evening and night work are less common now than they were during the 1970s. Between Midnight and 5AM, the least frequently worked hours, this decline has been steady over the years. Despite recent popular claims about the growing importance of people working on "Dracula time," the opposite has occurred: Work in the evening and at night has been decreasing.[8]

The declining fraction of total work performed in the evening and at night has not been replaced by a pronounced growth in the 9 to 5 workday. Instead, the change has been toward an expansion of the propensity to work at 6AM and especially 7AM, and at 5PM and 6PM. This does not mean that any individual worker (or group of workers) is putting in longer days.[9] Rather, it demonstrates a widening dispersion of what might be viewed as standard days that is occurring at the same time that the incidence of work at very unusual times is diminishing. While the patterns in Figures 2 are generally similar by sex, the secular changes in men's schedules are more pronounced than those in women's work. In particular, the growth in the fraction of work performed at 6AM and 7AM is significantly greater for men, as is the decline in the fraction performed between Midnight and 5AM.

Figure 2a. Adjusted Excess Probability of Work at Time t (Base 1973), Men

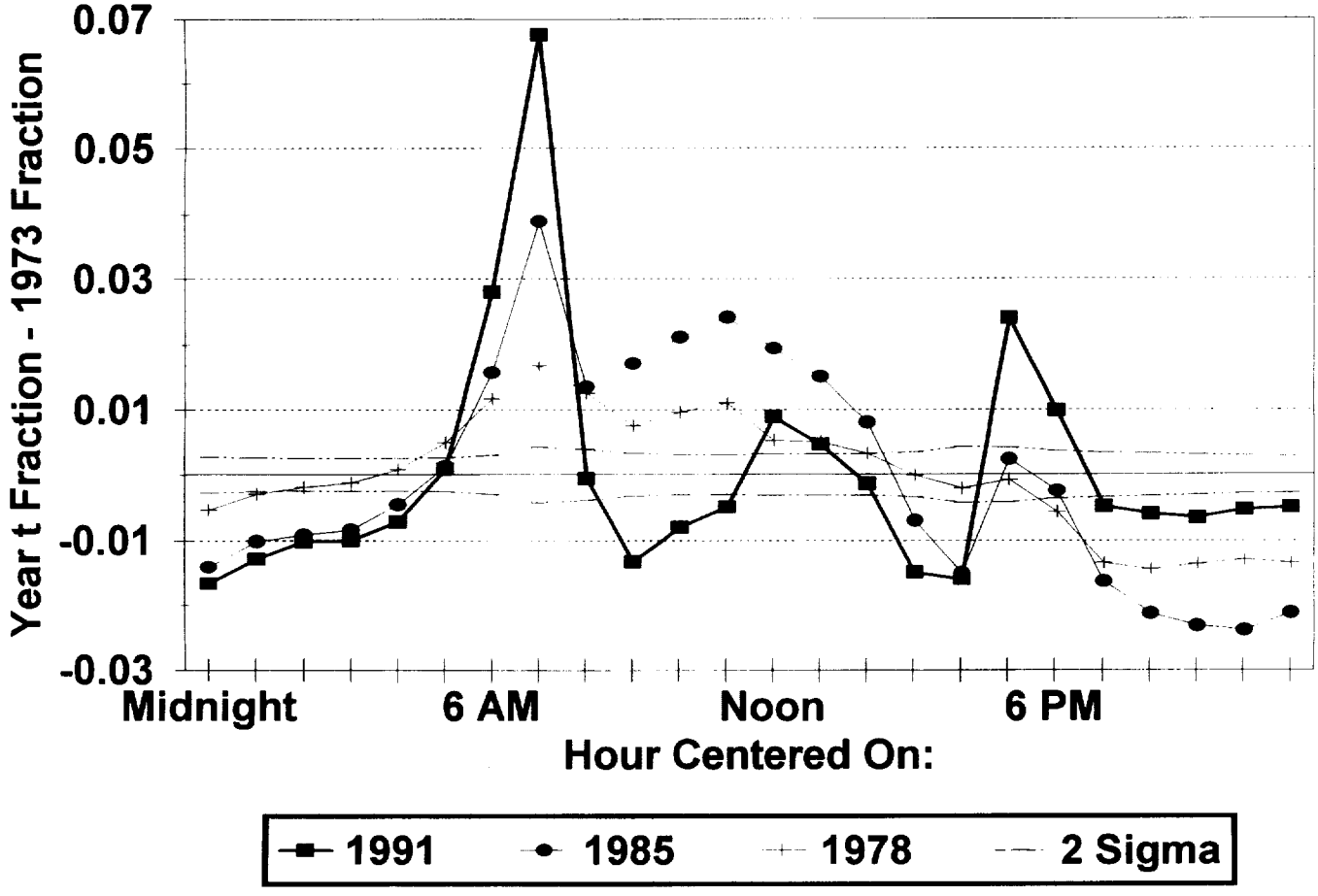
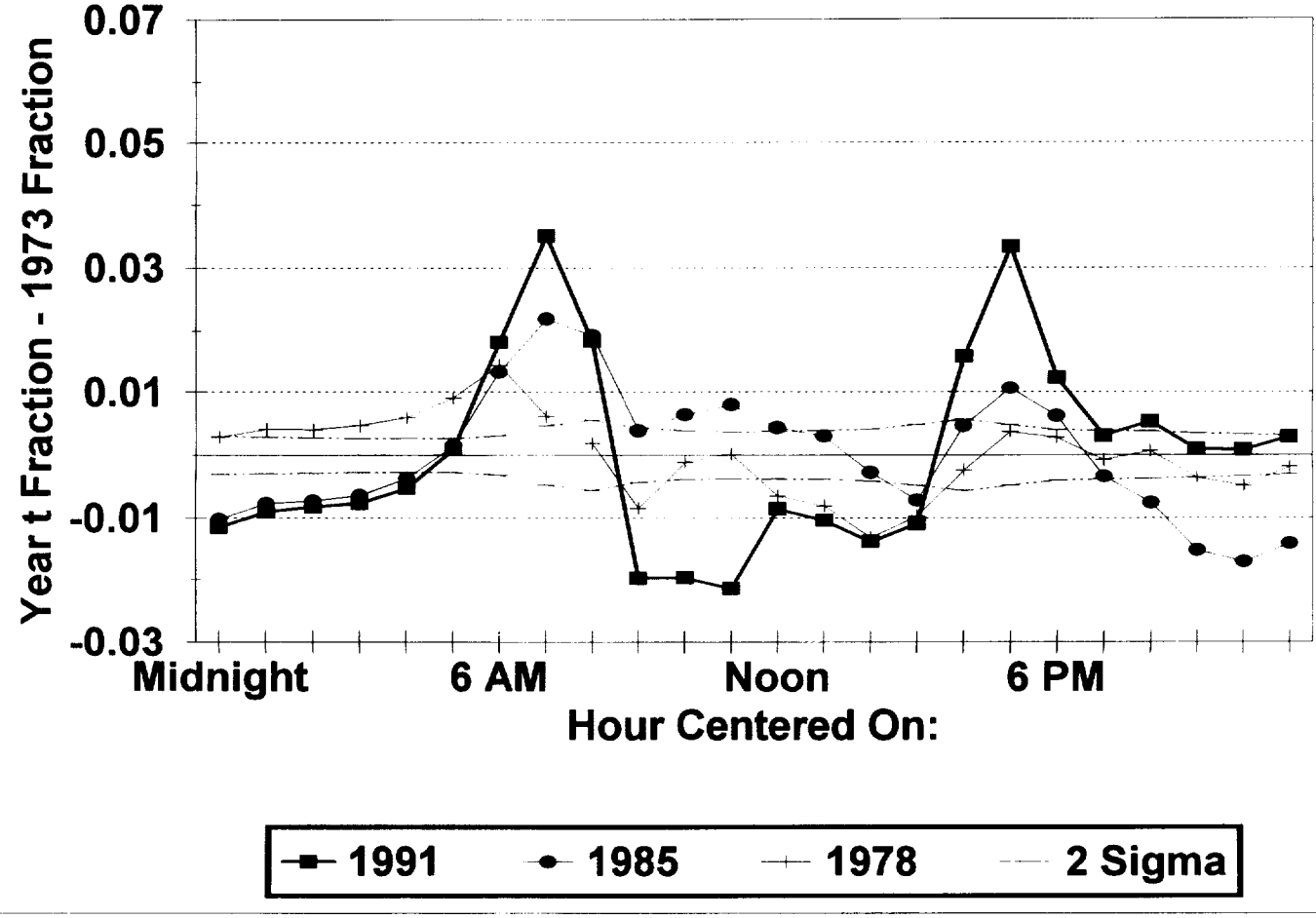


Figure 2b. Adjusted Excess Probability of Work at Time t (Base 1973), Women



One possible explanation for the trends in Figures 2 might be that they are based on data that reflect people's work time only on their main jobs. It might be that a growing number of second jobs are being worked evenings and nights. Various experiments with these data, however, suggest that this explanation is not supported by the workers' responses in the CPS.[10]

Still another possibility is that these trends reflect intercohort differences in workers' preferences, so that with the passage of 18 years cohorts whose members' aversion to evening and night work was small may have been replaced by subsequent cohorts whose members were strongly averse to such work. To examine this possibility I formed artificial cohorts by excluding workers over age 51 from the 1973 sample, under 21 and over 56 from the 1978 sample, etc., and calculated the $L^a_{ts} - L_{t,1973}$ for these artificial cohorts. For some t the trends were slightly more pronounced than in Figures 2, for others slightly less pronounced; but overall the results were essentially the same in these smaller samples. The trends are not the result of intercohort differences in preferences.

Are these striking changes in the timing of work simply the result of the shifting demographic structure of the labor force? Have they been produced by changes in the industrial structure of production? Or are there more subtle causes for what appear to be massive changes, including the nearly one-third decrease in the propensity of male workers to be on the job at night? To decompose the $[L^a_{ts} - L_{t,1973}]$ into a part resulting from shifts in the intercept and a part resulting from changes in those factors that determine L_{it}, I regress the $L_{t,1973}$ on the wide array of demographic variables and industry dummy variables discussed in Section III. The parameter estimates from those regressions are then used along with the means of the independent variables for s = 1978, 1985 and 1991 to predict the L^a_{ts} for those years. The new adjusted differences, $[L^{a*}_{ts} - L_{t,1973}]$, are thus purged of the effects of changes in the variables that are included in the regressions.

The square root of the sum over t of $[L^{a}_{ts} - L_{t,1973}]^2$ is shown in the first column of Table 1, while the square root of the sum over t of $[L^{a*}_{ts} - L_{t,1973}]^2$ is shown in column (2). As can be seen from column (1), and as is implicit in the graphs of the differences at each t in Figures 2, the patterns of dispersion of working times increasingly departed from the patterns observed in 1973.[11] Accounting for changes in demographic variables and in the mix of industries, as in column (2), we find that the general pattern is not greatly different: The indexes in column (2) are much higher in 1991 than in other years and, with the exception of men in 1985, the changes in the explanatory variables do not account for much of the changing timing of work.[12]

The unemployment rates for all civilian workers (male workers ages 20+) in the four years studied here were 4.9, 6.1, 7.2 and 6.7 percent. It is possible that what I am identifying as a trend is really just a cyclical response, since with data on only four time periods these are difficult to distinguish. Two facts argue against this interpretation: 1) While the national unemployment rate was lower in 1991 than in 1985, the decline in work at inferior times continued over that six-year period; and 2) Adding MSA unemployment rates to the estimates had no impact on the temporal changes in the patterns of work timing.

A final concern is that the nature of the CPS questions may have changed in such a way as to generate the apparent trend in work timing. From 1973 through 1978 the timing question was the first one asked in the May Supplement (administered at the end of the regular CPS questionnaire) and read, "At what time of day did ... begin work on this job most days last week?" In 1985 and 1991 it was the fourth question asked (following questions on hours per day and days worked per week) and read, "Last week at what time of day did ... begin work on this job most days." The similarity of these questions makes it difficult to believe that they could have generated the trends observed here

Table 1. Indexes of Changes in Work Timing, Subsequent Years Compared to 1973

Year	Unadjusted	Adjusted
	Men	
1978	0.0439	0.0399
1985	0.0834	0.0473
1991	0.0879	0.0857
	Women	
1978	0.0308	0.0398
1985	0.0497	0.0396
1991	0.0742	0.0728

[a]Adjusted using industrial attachment defined consistently over 1973-91 based on 58 1- and 2-digit industries, continuous measures of educational attainment and potential experience, and indicator variables for Hispanic, black, marital status, presence of children under 18, and location in the New England, mid-Atlantic or East North Central regions.

(or any other trend, for that matter). Moreover, the substantial changes from 1985 to 1991 in both Figures 2 and Table 1 suggest that the apparent trend does not merely reflect changes in the survey instrument between 1978 and 1985.[13]

The clear evidence is that there has a been a trend away from work in the evening and at night that is not accounted for by changing industrial characteristics or by changing demographics. I believe that the trends can be explained very simply by two facts. First, work at these times is inferior. The estimates underlying the calculations in Table 1 make it clear that the probability of working in the evening or at night diminishes with education level and is U-shaped in age. (Hamermesh, 1996, Chapter 3, presents the details of this evidence for the 1991 cross-section.) Workers with more human capital, as indexed by these most important observable characteristics, are less likely to work then. By inference, people do use some of their earning power to work at more desirable times.

The second fact is the apparent growth in real earnings over this period. While some (Council of Economic Advisors, 1995, p. 177) have argued that median real earnings have fallen somewhat, others (Advisory Commission, 1995) have pointed out problems with the price indexes used to adjust nominal earnings.[14] Taking even a conservative adjustment of reported earnings figures to account for the overstatement of consumer price inflation suggests that real wages of the median worker have grown over this quarter century. Coupling this conclusion with the inferiority of evening and night work yields a simple explanation for the trend, namely that people with rising earning power have increasingly avoided the disamenity of working at undesirable times. That most of the change in work timing, especially in the pattern of night work, came after 1978 is consistent with the

observation that real earnings rose least (fell most) during the quinquennium 1973-78, and thus with the effect of higher full earnings on timing that I outlined in Section II.

The declining prevalence of evening and night work has been coupled with the sharp growth of work at the fringes of the traditional work day. The implications of these two changes for the overall jointness of work (what one might call the total temporal agglomeration of work in the American economy) is unclear, since they work in opposite directions. To examine the contemporaneity of work I form a Top 8 concentration ratio, measuring the fraction of total work time performed during the eight most frequently worked hours.

Table 2 presents the Top 8 concentration ratio of work time by sex and for the entire work force. While all the (roughly) quinquennial changes are statistically significant, the economic importance of the changes in the contemporaneity of work between 1973 and 1985 were tiny. The change from 1985 to 1991 is much larger, however, suggesting that work in the United States today seems to be performed with somewhat less contemporaneity than had been true earlier. This is true both by sex and for all workers taken together.[15]

V. The Distribution of Work Times

Probably the most striking development in the American labor market since 1970 has been the rising inequality of wages (Bound and Johnson, 1992; Juhn et al, 1993). Whether measured parametrically or not, the evidence seems quite clear (and nearly undisputed) that the returns to skill have risen, a change that is observable in the United States even within a variety of demographic and other disaggregations.[16] One might argue that the rise in wage inequality has perhaps been at least partly offset by a change in the distribution of the amenities that, along with wages, represent the total returns to work. The discussion surrounding (4) suggests that such an expectation is inconsistent

Table 2. Concentration Ratios of Work Timing (standard errors in parentheses)

Year	Men	Women	All
1973	0.7223	0.7769	0.7429
	(.0019)	(.0023)	(.0014)
1978	0.7241	0.7704	0.7428
	(.0017)	(.0021)	(.0013)
1985	0.7306	0.7743	0.7499
	(.0016)	(.0018)	(.0012)
1991	0.7102	0.7574	0.7298
	(.0017)	(.0018)	(.0013)

with consumer behavior, though it could result if nonneutral technical change altered the technology of producing amenities in such a way as to benefit low-wage workers particularly. Absent such a change, we should expect that the distribution of amenities will have become less equal along with the distribution of wages.

The predicted link between the inequality of wages and of amenities applies to the particular amenity on which I have focused, the timing of work. In light of the arguments in Section IV we should expect to see that work at night and during the evening has become relatively more common among workers at the lower end of the wage distribution. Since the incidence of such work fell on average over this period, at the very least we should observe that the decline was less rapid among low-wage than among high-wage workers.

To examine this prediction I sort the four May CPS samples by weekly earnings and divide the resulting samples into quartiles.[17] The samples include all workers on whom information on earnings and weekly hours is available.[18] Workers with an hourly wage rate below $1 in 1973, $1.50 in 1978, $2.25 in 1985, and $2.75 in 1991 are excluded from the respective samples used in this section, as are workers whose scheduled weekly hours were less than 35.[19]

Here and subsequently I base the comparisons of the distributions of the timing of work on the series D_{its}, calculated for each worker i in each year s as the fraction of the person's workday accounted for by effort during the particular hour t. This approach standardizes for differences in total hours supplied, in particular for the positive correlation of changes in the dispersion of hourly wages and weekly hours documented by Murphy et al. (1991) that would contaminate comparisons of the L_t across years. I examine the changing distribution of the amenity, timing of work, by calculating the averages of these series for each quartile of the wage distribution for each sex for each

year s. As a check that this break-down mirrors the rise in wage inequality that has been demonstrated on other CPS samples, one should note that weekly earnings in the top quartile of full-time male workers in these samples rose by 29 percent between May 1973 and May 1991 relative to that in the bottom quartile.[20]

Inferring the changing distribution of work times can best be done graphically. Figures 3 and 4 present the ratios $D_{ts}/D_{t,1973}$ for each earnings quartile, for men and women separately, for s = 1978, 1985 and 1991. Moving through Figures 3a-3c, one sees that the differences in these ratios across the quartiles become more pronounced over time. Most importantly, in 1985, and especially in 1991, the ratios are far below one for workers in the top quartile of the earnings distribution in the evening and night hours. The ratios are around one, and in 1991 are greater than one at these same times for workers in the lowest earnings quartile. Among female workers the differences in the distributions of work time by earnings quartile are less pronounced. Even here, though, the incidence of night and evening work appear to have fallen more among workers in the upper quartiles.

Another way of examining the changes in the distribution of work times is to compare "double differences" in the D_{ts} across earnings quartiles and over time. Figures 5 present such comparisons for the top and bottom quartiles between 1973 and 1991 separately for male and female workers. 95-percent confidence limits are shown by the thin lines in each figure. The most important results in Figure 5 are the significant negative double differences in the evenings and at nights for male workers. At all hours between 6PM and 5AM, exactly those times that cross-section evidence and common sense suggest are inferior, the propensity to work decreased relatively among those workers whose wages increased relatively. While the results are quite weak among women, they are

Figure 3a. 1978 Timing vs. 1973 Timing Men by Earnings Quartile

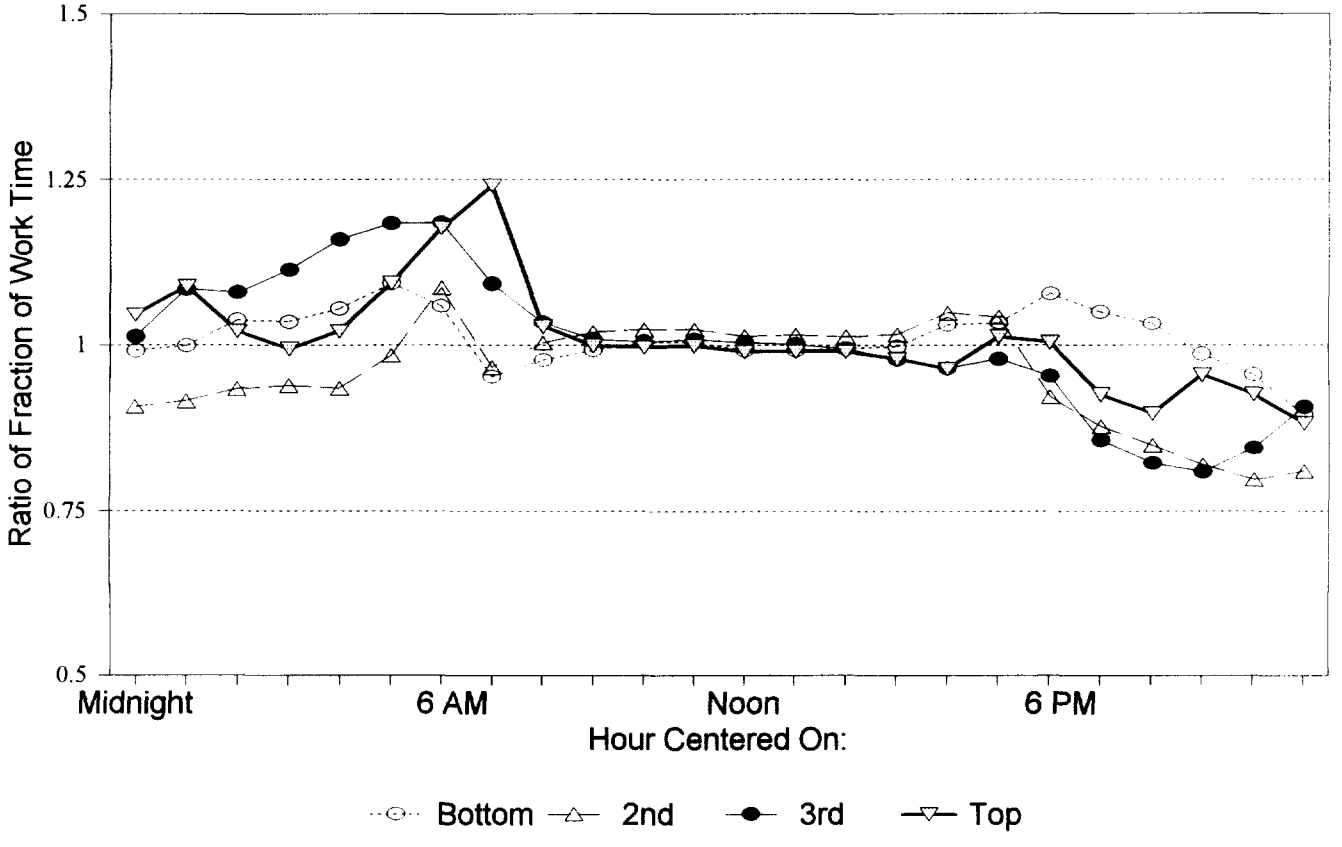


Figure 3b. 1985 Timing vs. 1973 Timing Men by Earnings Quartile

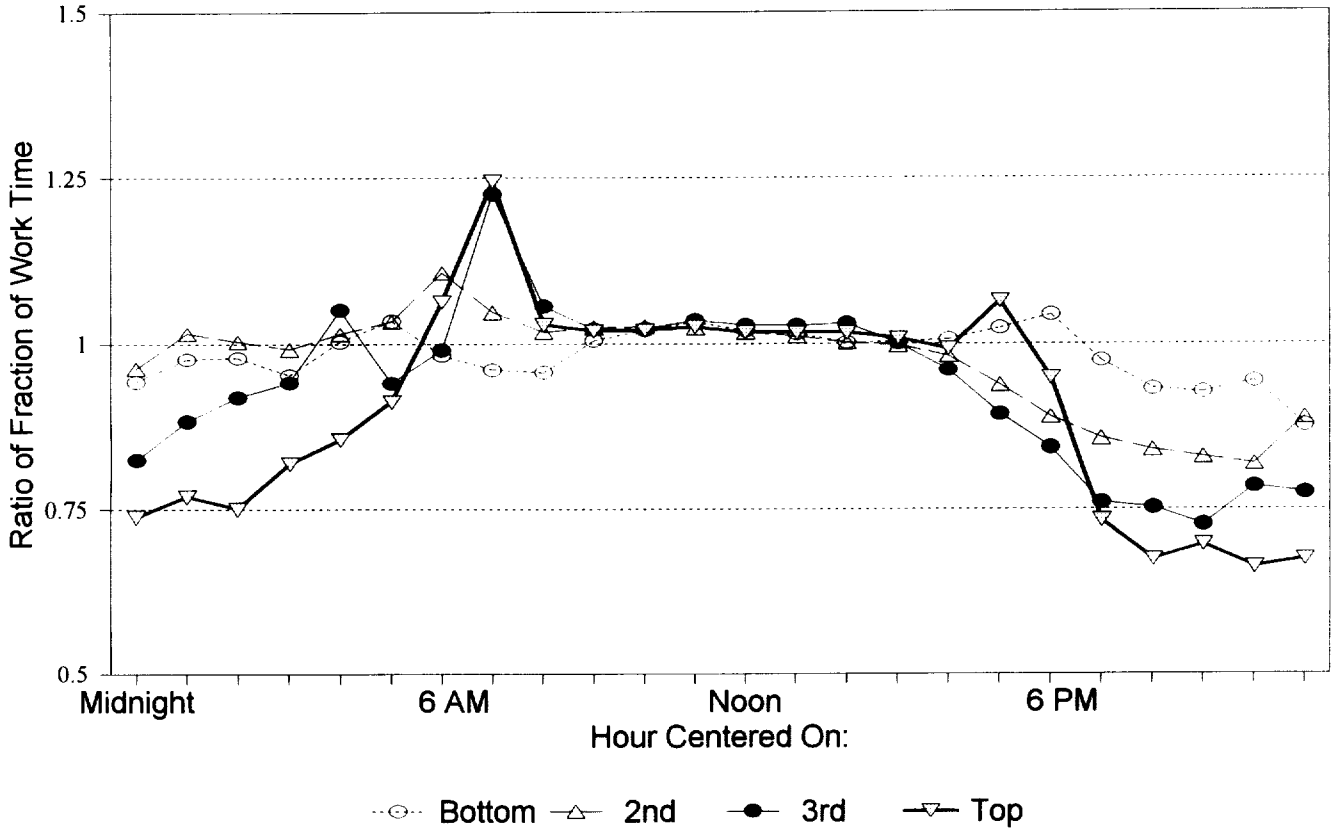


Figure 3c. 1991 Timing vs. 1973 Timing Men by Earnings Quartile

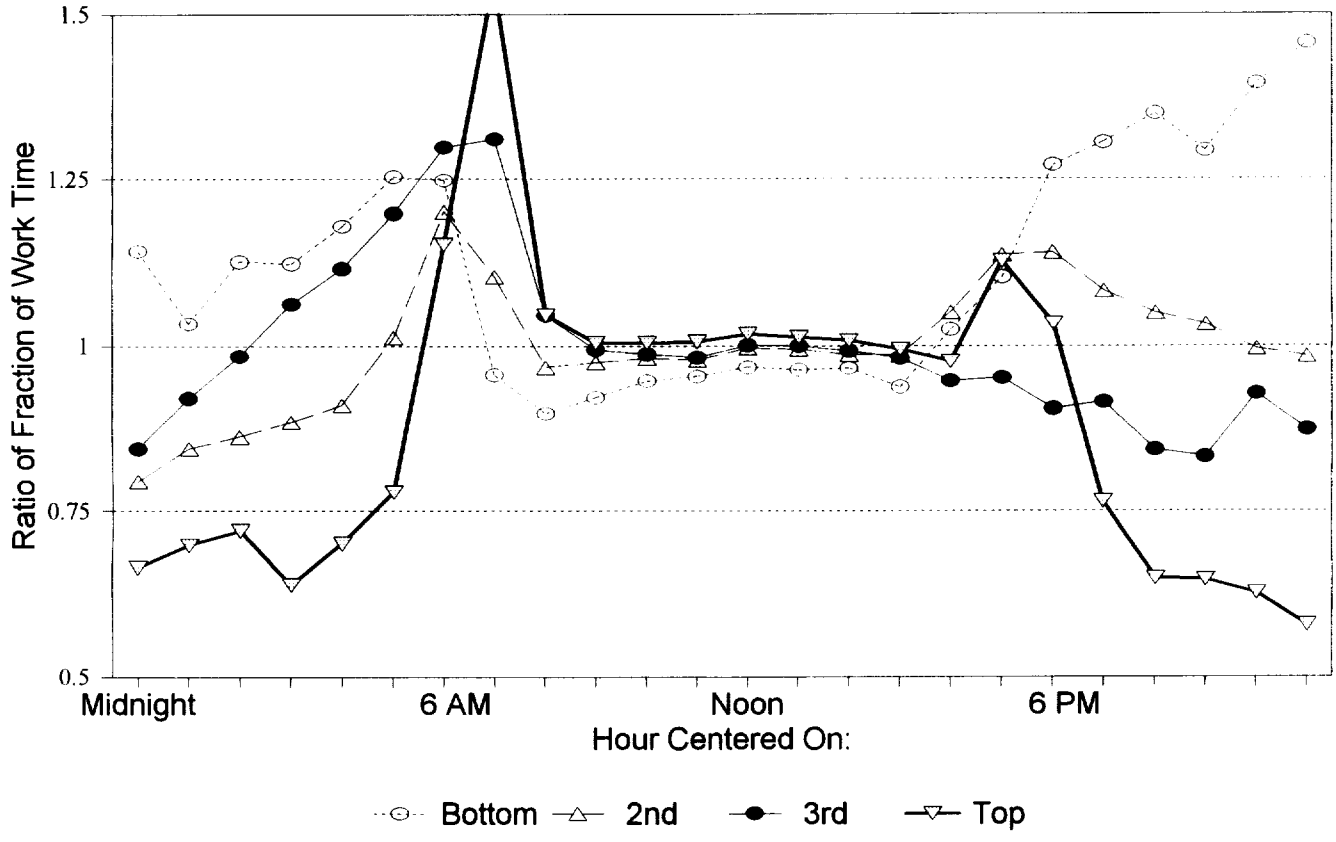


Figure 4a. 1978 Timing vs. 1973 Timing Women by Earnings Quartile

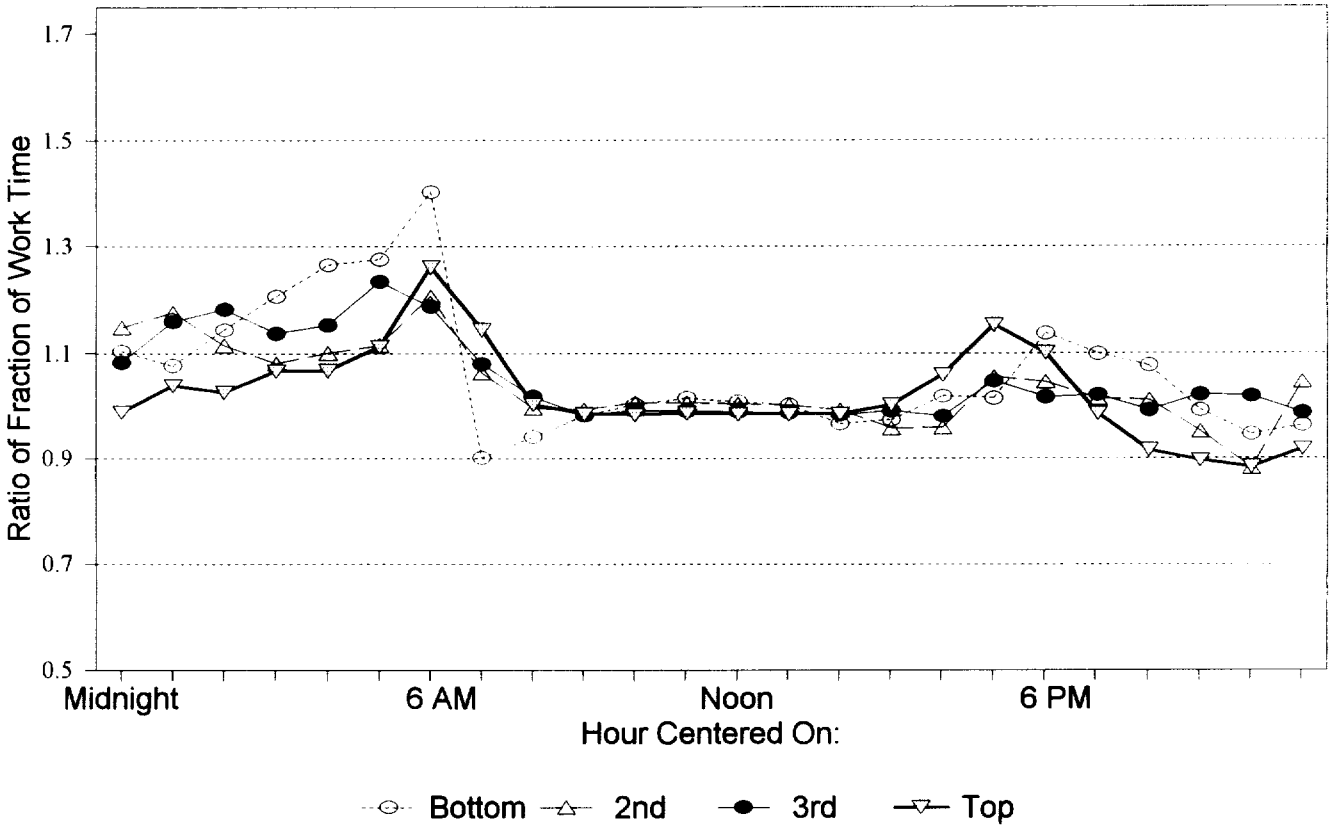


Figure 4b. 1985 Timing vs. 1973 Timing Women by Earnings Quartile

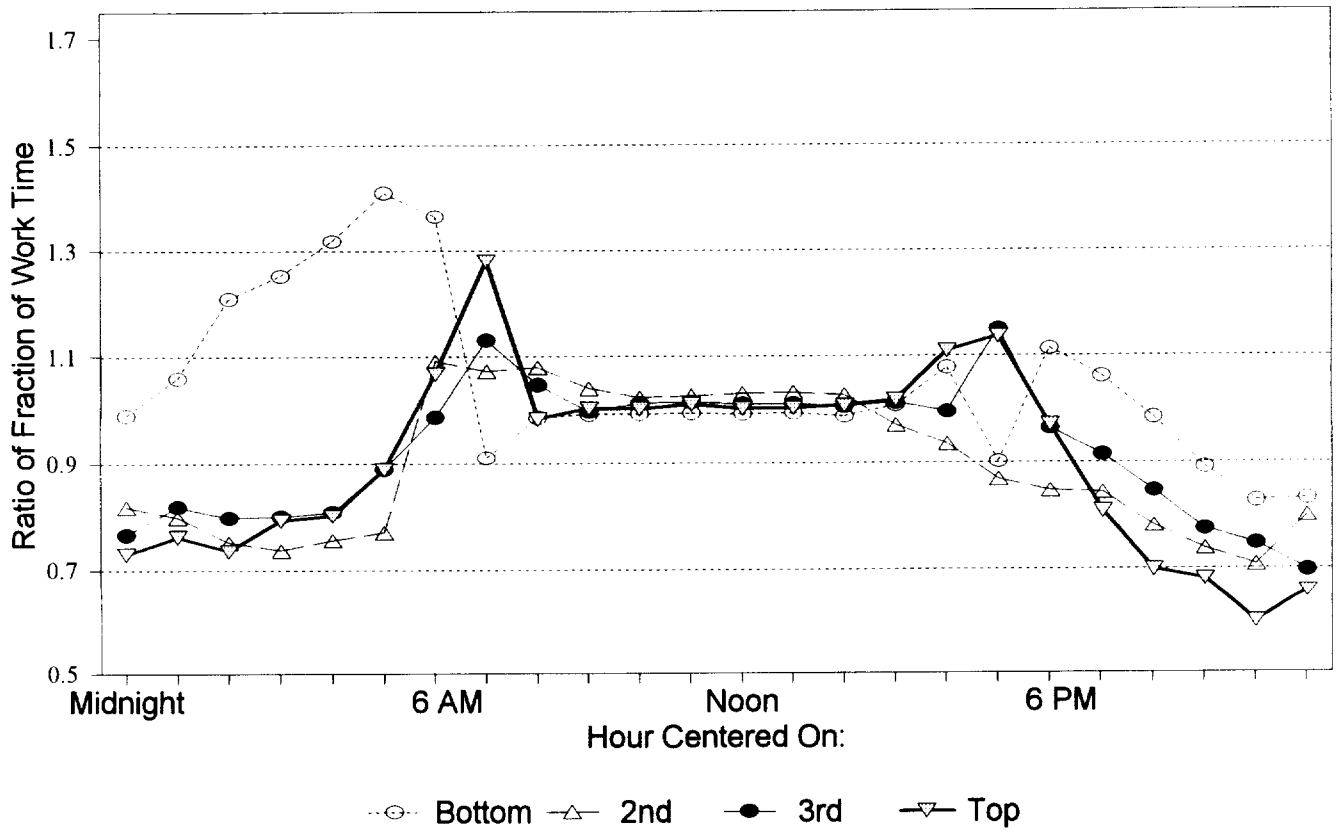
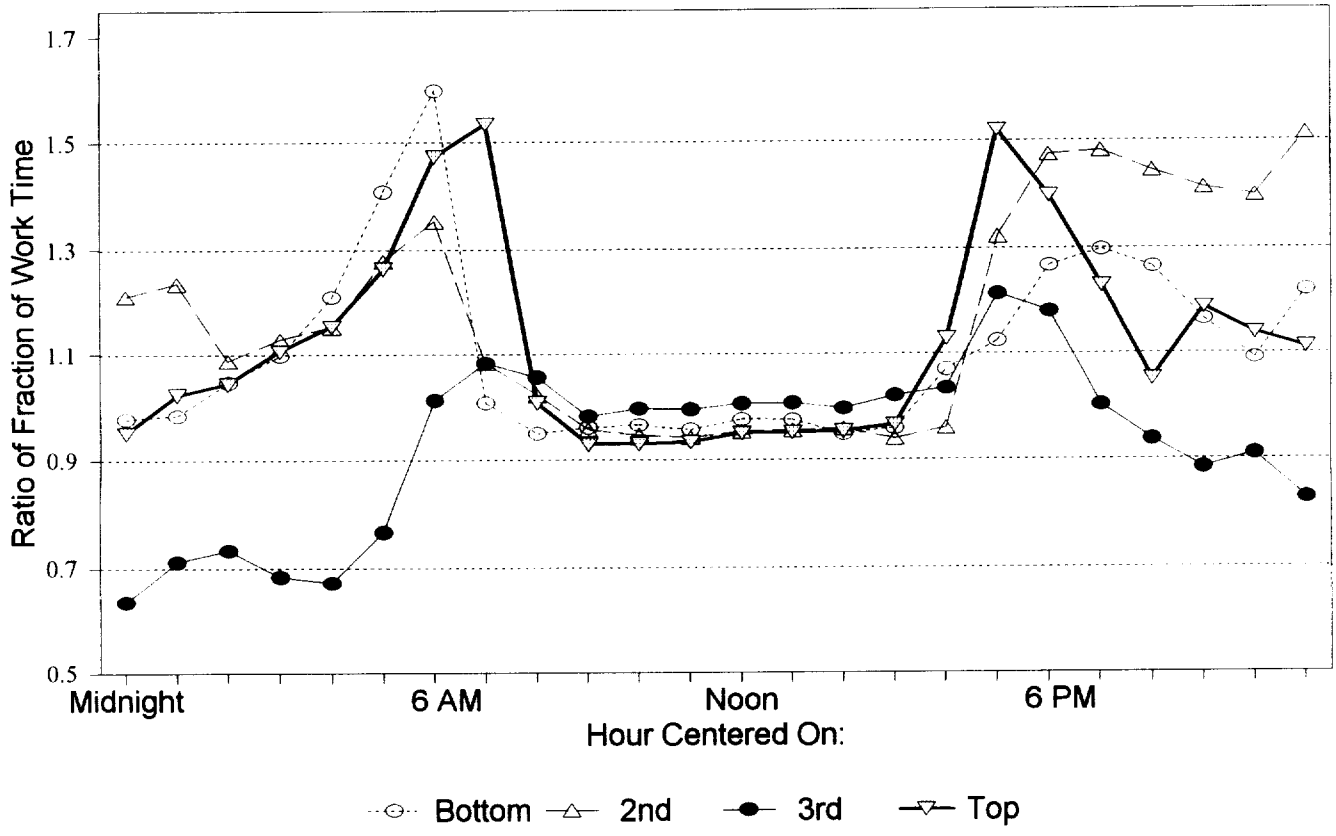


Figure 4c. 1991 Timing vs. 1973 Timing Women by Earnings Quartile



extremely strong for men (among whom earnings inquality rose more than among women). Among female workers only the negative double differences at 7AM and 5PM depart significantly from zero.

The overall patterns of changing timing make it absolutely clear that, at least for the amenity of work timing, the changing dispersion of the distribution of the amenity has mirrored the changing dispersion of wages. Accounting for changing inequality in the timing of work strengthens the conclusions about how the distribution of inequality in the returns to work in the United States has changed since the early 1970s.

VI. Explanations and Alternatives

The patterns in Figures 2-5 are consistent with the brief supply-side theoretical discussion implicit in (3) and (4). The two new facts established here -- that there has been a secular shift away from night work, and that this shift has been greatest among workers who have benefited most from the increase in wage inequality that has occurred in the United States -- can be easily rationalized by pointing to the inferiority of evening/night work. The question is whether other explanations consistent with these facts are equally simple and whether there are additional, related facts that are inconsistent with this explanation.

Inferring causation in implicit markets is extremely difficult under any circumstances. I cannot claim that the broad trends in the timing of work in the United States depicted in Figures 2 could not have resulted from changing technology. For example, these new facts could have been generated by nonneutral shifts in firms' profit functions (2). One might argue that we have already refuted this possibility, since the results in Table 1 showed that the trends in work timing are not removed when changes in industrial structure are held constant.

Figure 5a. Work Time Double Difference 1991-1973, Top-Bottom, Men

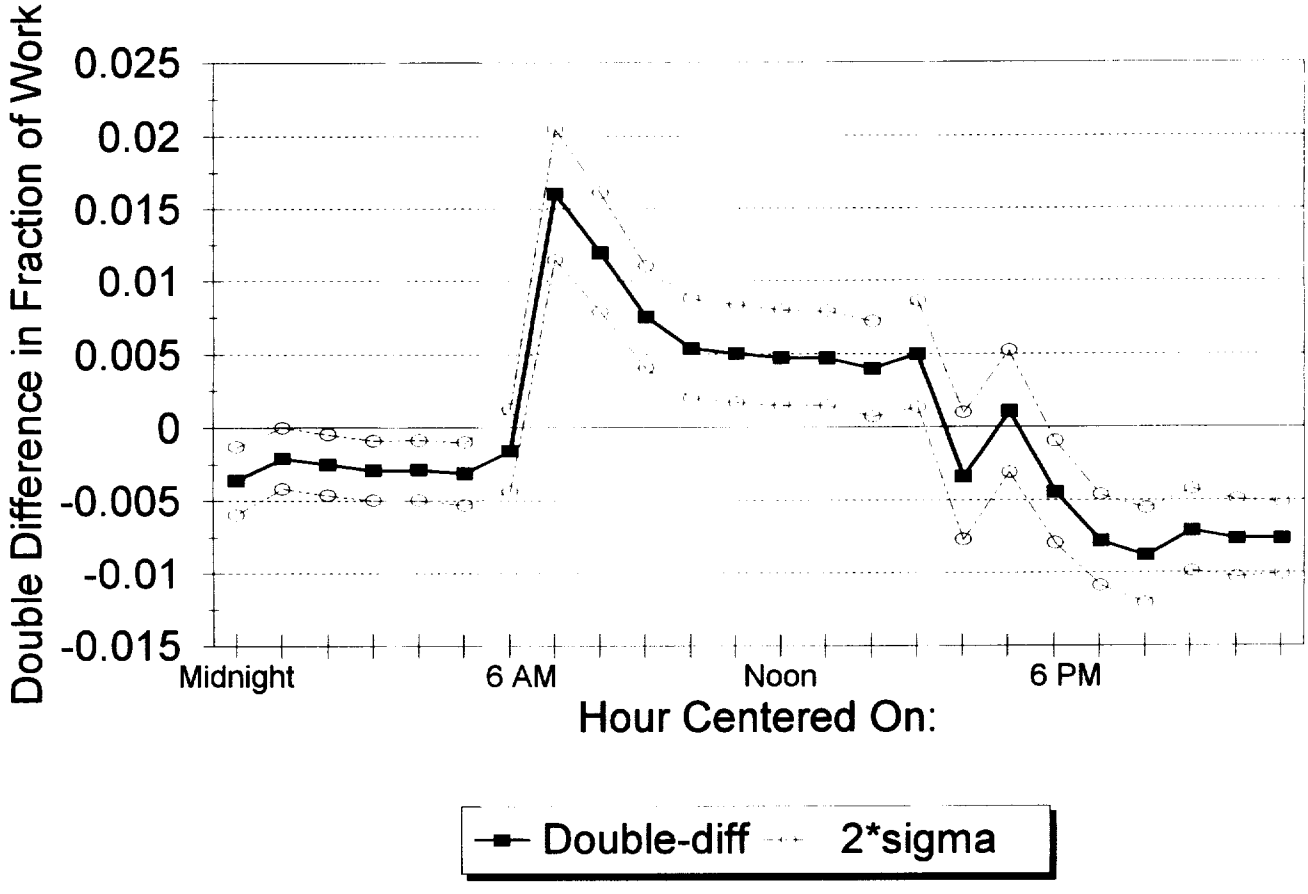
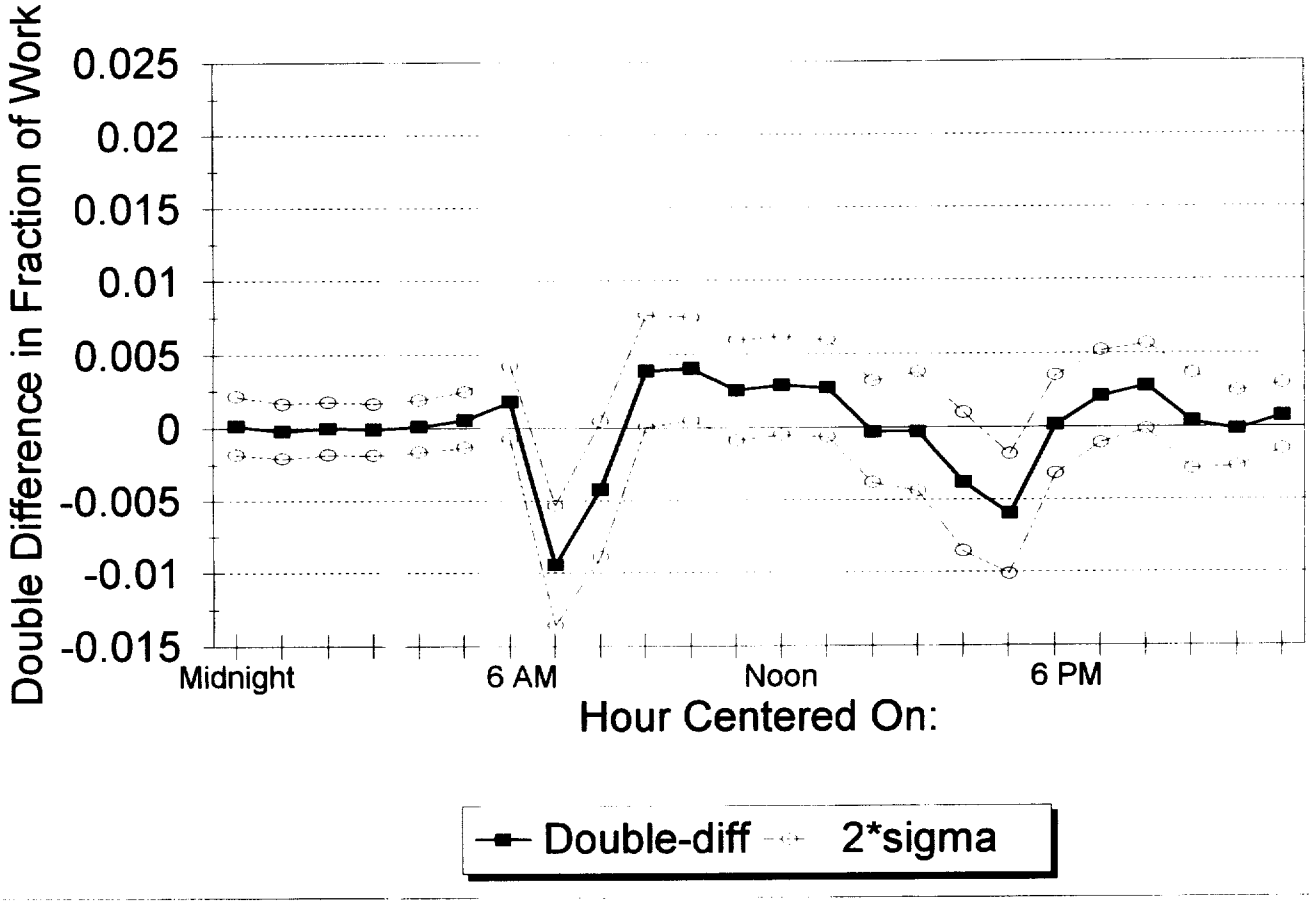


Figure 5b. Work Time Double Difference 1991-1973, Top-Bottom, Women



One hint of an additional test for nonneutrality takes off from the argument that an important change in the organization of work might have resulted from the increasing ease of communication internationally and across time zones. That change in technology should presumably have had the biggest impact on the timing of demand for clerical and managerial workers, since they might be expected to interact most with workers in other locations. Obversely, it is difficult to argue how the greater ease of communications would affect the timing of the productivity of work by blue-collar employees. If this "globalization" argument is correct, we will observe that the decline in evening and night work has been more pronounced among blue-collar workers than among clerical and managerial workers. A first cut at this hypothesis is presented in Figures 6, based on the $[L^{a}_{t,1991} - L_{t,1973}]$. For neither men nor women is there any evidence whatsoever of differences between the two broad occupation groupings in the sizes of the decline in the propensity to work in the evenings or at night. A test of a simple technology-based explanation of the pattern of changes in work timing fails completely.

One might argue that the gloabilization of work could not have affected lower-paid clerical and managerial workers, and that its impact would be apparent only if we examine changes in the relative timing by earnings group within occupations. To study this possibility I examine how the D_{ts} changed between 1973 and the later samples by wage level within the occupation groups blue-collar and clerical/managerial workers (for men only). These calculations compare the upper to the lower halves of the wage distributions, and they aggregate the May 1985 and 1991 samples.[21] Before discussing the changing patterns of the D_{ts}, it is first worth noting that even within these occupations wage inequality increased between the early 1970s and the late 1980s/early 1990s in the United States: The average weekly earnings of full-time blue-collar (clerical/managerial) workers with

Figure 6a. 1991 Timing vs. 1973 Timing
Men by Occupation

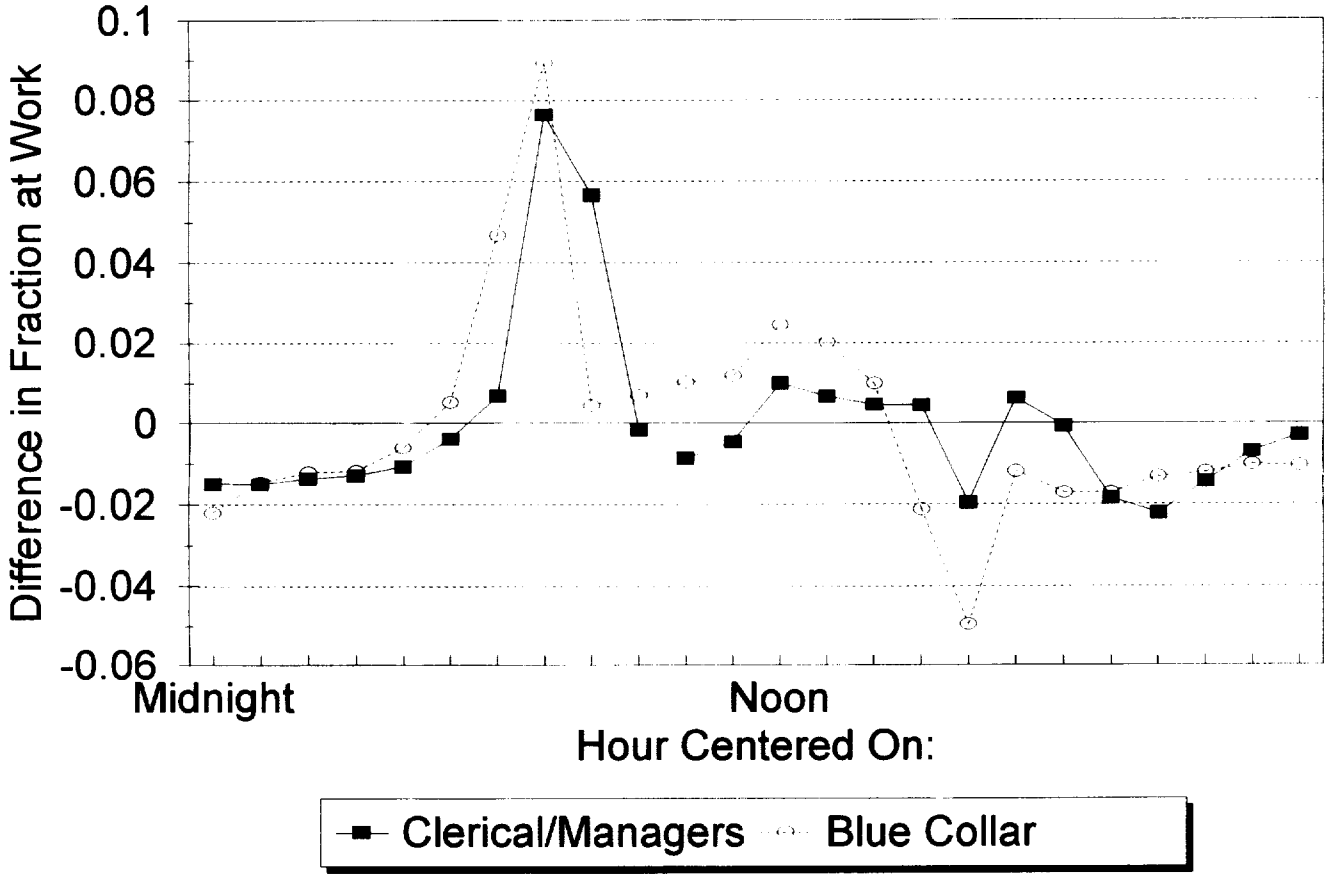
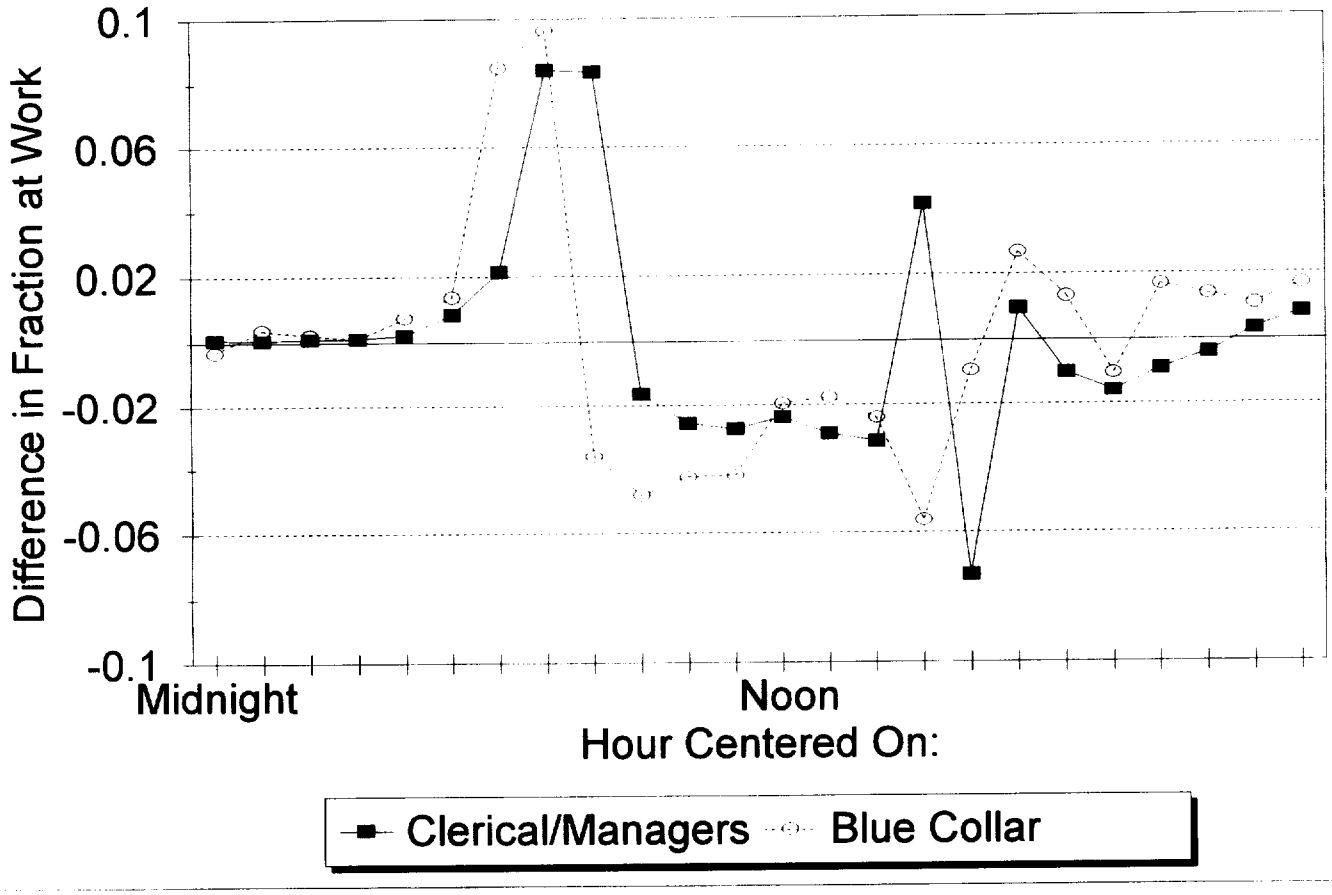


Figure 6b. 1991 Timing vs. 1973 Timing
Women by Occupation



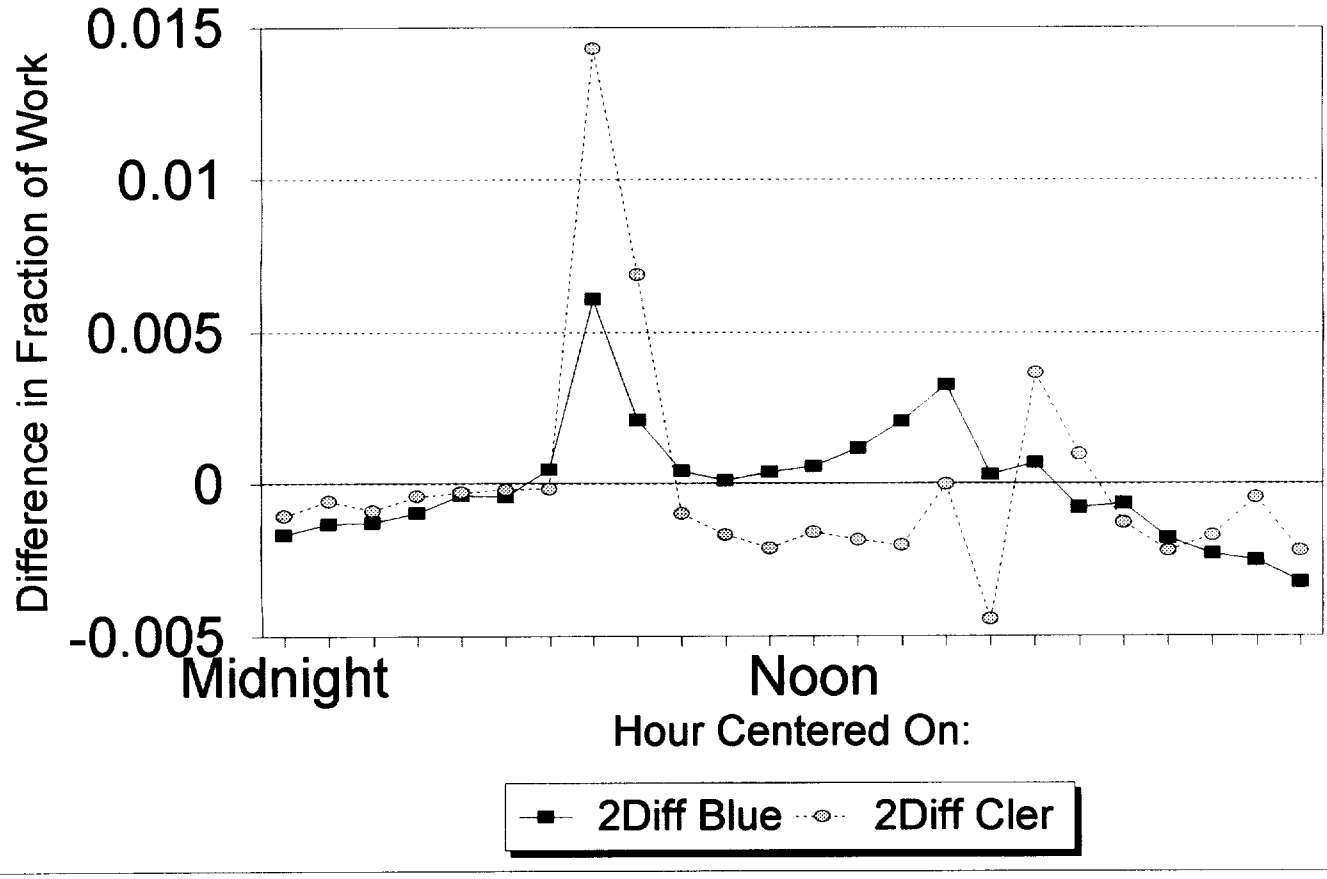
earnings above the median rose by 11 (12) percent between 1973 and 1985/91 relative to those of workers in the same occupation whose earnings were below the median.

Figure 7 presents the differences in the fraction of total work accounted for at each hour of the day between workers in the upper and lower halves of the distributions of earnings, itself differenced between 1985/91 and 1973. These double differences are presented for both major occupations and are analogous to those in Figures 5 (except that these cut the distributions into halves instead of quartiles and aggregate 1985 and 1991). The double difference for blue-collar workers shows that in these occupations, as for the entire labor force on which the calculations were presented in Table 5a, we again observe a larger fall in the fraction working evenings and nights at the upper part of the earnings distribution. Among clerical and managerial workers the same thing occurred, albeit in somewhat attenuated form.

The evidence in Figure 7 suggests that nonneutral technological change played little role in producing the changes in the timing of work that I documented in Section IV. This does not mean that technical change cannot be an important determinant of work timing, as historical comparisons to eras before the invention of inexpensive high-quality artificial lighting surely make clear. It does imply, however, that if we are to explain recent changes as the result of demand-side forces, we need more subtle explanations than come readily to hand.

One possible such explanation is that technology increased the jointness of high-skilled workers' time (before the late 1980s when very rapid home telecommunications became possible), causing them to switch disproportionately away from evening and night work (as the data show). This story is consistent with the facts for 1973-85 in Figures 2-5, but inconsistent with the continuing decrease in evening and night work between 1985 and 1991. It is also inconsistent with evidence of

Figure 7. Men, Double Differences, Cler./Man and Blue Collar



a steady increase in the contemporaneity of work timing among men in the upper quartile of the earnings distribution from 1973 through 1991.[22] It is also a much more complex story than the simple explanation based on income effects in the demand for amenities that I have offered.

If changes in full income have produced the relative decline in evening and night work, that should be reflected in a simultaneous increase in the θ_t associated with such work. Table 3 shows estimates of these parameters (actually, of the pay premium received by observationally identical workers who worked at least four hours between 8PM and 6AM). Included in these equations are all the demographic measures and the indicator variables for industrial affiliation that were used as controls in calculating the adjusted indexes L^{a*}_{ts}.[23] The expected positive θ_t do not generally appear. Indeed, and most striking, for men the estimated premium for evening/night work becomes increasingly negative over this period. Does this apparent anomaly contradict the otherwise satisfactory explanation for the changes in the quantity of work performed at different times?

Underlying these results and those in Sections IV and V is the well-known (e.g., Juhn et al, 1993) fact that much of the rising inequality in earnings in the United States cannot be explained by increases in the returns to measurable skill, such as education and experience. Rather, the returns to unobservable quality (what one might call unmeasurable skills) have apparently increased. Consider how this fact might affect the θ_t estimated from standard earnings equations, such as those presented in Table 3. I assume that all the measurable correlates of full income have been accounted for and consider only unobservables. (This means that one could not hope to estimate a selection equation that solves this problem, since the issue is inherently one of unobservable factors that determine productivity and selection together.) Wages in each sector are:

(5a) $\quad w_{ins} = \alpha_s v_i + \beta_s + \theta_s ;$

Table 3. Estimated Premia Associated With Evening/Night Work

Year	Men	Women
1973	.0178	-.0083
	(.0095)	(.0135)
1978	-.0242	-.0933
	(.0120)	(.0146)
1985	-.0589	-.1272
	(.0214)	(.0254)
1991	-.1005	-.0429
	(.0199)	(.0236)

[a]Based on estimates of equations describing the logarithm of weekly earnings including indicators for 58 1- and 2-digit industries, continuous measures of educational attainment and potential experience, and indicator variables for Hispanic, black, marital status, presence of children under 18, and location in the New England, mid-Atlantic or East North Central regions.

(5b) $w_{ids} = \alpha_s v_i + \beta_s + \theta_s$,

where $v_i \sim \phi(0,1)$ (unit normal) is worker i's unobservable skill, n and d denote "night" and "day" work, θ_s is the true premium for night work at time s, and α_s and β_s are positive parameters that are increasing over time. (The change in α reflects growing dispersion in the returns to unmeasurable skill, that in β reflects a general secular rise in real full incomes.) Workers choose night work if $\theta_s > \delta w_{ids}$, where $\delta > 0$ indexes workers' distaste for night work.

Given the distribution of v, a fraction:

(6) $N_s = \Phi\left([\theta_s - \delta\beta_s]/\delta\alpha_s\right)$,

of the work force will be working at "night." Together with firms' relative demand function for night and day workers that is decreasing in θ_s , (6) determines both the allocation of workers by timing and the premium for night work. The expected wage of "night" workers at time s is:

(7) $E(w|n) = \phi\left([\theta_s - \delta\beta_s]/\delta\alpha_s\right)/N\left([\theta_s - \delta\beta_s]/\delta\alpha_s\right)$,

the inverse Mill's ratio describing the mean of the left-truncation of a unit normal deviate. With β_s and α_s increasing in s, but β_s/α_s also rising, E(w|n) will decrease over time compared to the mean of all wages. When we estimate θ_s from standard log-earnings equations, we will find that the estimates become increasingly negative with s. This arises because the mean unobserved skill differential between night and day workers rises as the returns to unobserved skills and average real wages increase, and because, as Hwang et al (1992) demonstrate, the positive correlation of unobserved and observed skills generally leads to underestimates of compensating wage differentials.

VII. Conclusions and Additional Approaches

The most important finding of this study is that work in the evenings and at night declined sharply in the United States between the 1970s and the 1990s. At the same time, however, the regular workday spread out somewhat from the archetypal 9 to 5 range. None of these changes was due to the changing demographic structure of the American labor force; more important, none resulted from a shift in the mix of industries (e.g., from a shift away from manufacturing and toward retail trade and services). We also observed a decline in the contemporaneity of work in the 1990s; the decline in work in the evenings and at night was more than offset by the growth in work at the "fringe times" in which work had previously been performed less frequently.

Cross-section evidence demonstrates that evening and night work are inferior. The decline in such work is thus consistent with rising real wages, as workers have used their growing full earnings to "buy" more of the amenity, work during the standard workday. Since the incidence of evening and night work has fallen most among workers in the upper quartile of the distribution of earnings, this view of work timing as an amenity is consistent with the often-noted rise in earnings inequality in the United States since 1970. The absence of major differences in the patterns of timing by occupation, and the observation that the declines cannot be explained by industrial shifts, suggest that the fall in evening and night work and the correlation of changes in the incidence of such work with changes in wage inequality do not result from nonneutral changes in technology across the workday.

Is the American experience unique? The theory is general and should be generally applicable. While data are not easy to obtain, the changing timing of work in other industrialized economies should be examined. A very stringent test of the view of work timing as an amenity that underlies

this study would involve reproducing these results on data for an economy where wage inequality had not risen during this time period. If this view is correct, and assuming that the same technology is available in both countries, we should find that the overall incidence of evening and night work had declined elsewhere too, but that the drop was not especially concentrated among higher-wage workers.[24]

The theory of the implicit market for amenities is very well developed and has been tested in a large variety of contexts for many different amenities, particularly those that are job-related. The work here represents the first attempt to use that theory to draw inferences about secular changes in the level and distribution of outcomes in the market for an amenity. The results are indicative of the power of that extension and imply that changing patterns of other job amenities could be examined fruitfully. Indeed, this approach could be used to revivify the increasingly repetitive research on changing wage inequality by extending it to the study of changing inequality in the returns to all aspects of work.

While I have concentrated on one aspect of the timing of work, secular changes, we need to integrate the notion of work timing into a variety of areas of applied economics. Evaluations of household welfare should account for the timing of the households' economic activities (including work), not merely how much of each activity is undertaken. Since public programs that alter incentives for time allocation presumably also alter incentives for timing, the analysis of the welfare implications of these programs should consider how they affect timing. The role of coordination in determining macroeconomic activity might benefit from considering the demonstrably important and changing role of temporal coordination of work, just as macroeconomic theory has benefited (Benhabib et al, 1991) from considering the role of household production. Most generally, our

analysis of the distribution of the returns to activities and the efforts involved in generating those returns needs to account for **when** activities are undertaken, since their quantities and the prices at which they are transacted are determined in part by their timing.

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FOOTNOTES

1. Hamermesh (1996, Chapter 3) examined this issue cross-sectionally for the United States and Germany without testing any hypotheses. Among sociologists Szalai (1972) presented a graph showing the timing of different activities in a sample of U.S. cities; Presser (1987) examined the timing of spouses' work. (See Gershuny and Sullivan, 1996, for an excellent summary of this literature.) Geographers too have paid some attention to this issue (Parkes and Thrift, 1980).

2. A good, though fictional example of this is described by Farmer (1985), with overcrowding having led society to require that each member be frozen for six of each seven days. People are aware of the existence of the other 6/7 of humanity, but they never interact with them.

3. In some countries, e.g., Germany, these differentials are set by industry-wide collective bargaining but are quite explicitly adopted by nonunionized firms in the same industry. Interestingly, it appears that these bargained differentials are wider than the mostly market-generated premia that exist in the United States.

4. Based on CPS data tabulated for May 1991.

5. Ideally one would want to include information on the presence of pre-school children. While such data are available in the later years of this study, only information on the presence of any minor children is available for the earlier years.

6. For the few observations that are topcoded I multiply the topcoded amount by 1.5.

7. Although this adjustment is necessary to ensure strict comparability across the four years, in fact the differences in average hours are sufficiently small that the qualitative conclusions are unaltered if they are based on the averages of the unadjusted L_{it}.

8. Newsweek, July 12, 1993, p. 68.

9. In these data hours of work change very little and show no trend, as one would expect from the evidence in Coleman and Pencavel (1993).

10. Data are available on the timing of second jobs in 1985 and 1991, but not in the earlier years. If we exclude all workers with second jobs, we still find that, for example, the fraction of women working at 3AM fell from .063 to .056, and among men it fell from .085 to .071 between 1973 and 1991. If we exclude only those workers who are likely to have been on a second job on more than one or two days -- who worked at least 10 hours per week on such a job -- the results are almost identical to those presented in Figures 2.

11. One reason why people might believe that evening and night work have become more common is that retail outlets appear to be open longer hours. There is some truth to this: Among men in retailing the fraction of work performed between midnight and 5AM rose from .028 to .033 from 1973 to 1991. Among women the fraction fell from .028 to .019.

12. As yet another check on the possibility that changing demographics account for the trends, I restricted the samples to single workers. The trends found for the entire samples are equally apparent mutatis mutandis in these restricted samples.

13. Nor does it seem likely that these changes could be explained very well by changes in commuting time. Between the 1980 and 1990 Censuses the mean travel time to work did rise, but only from 21.7 to 22.3 minutes.

14. Indeed, it is not even clear (Slesnick, 1993) that real living standards at the lower end of the income distribution diminished in the 1970s and 1980s.

15. I also calculated a Herfindahl-type index over the fraction of work time performed at each hour of the day in each year. This too indicated only small changes in concentration from 1973 to 1978, and from 1978 to 1985, but a substantial decline in concentration from 1985 to 1991.

16. Some observers on the political right would disagree (Armey, 1995, pp. 37-38).

17. I use quartiles instead of the deciles that are more common in the recent literature on wage inequality because the samples of respondents in the May 1985 and 1991 CPS on whom wage data are available are fairly small.

18. All the results were produced for the samples sorted by hourly earnings, with no qualitative difference between those results and the ones reported in the text. Yet another set of essentially similar results is based on earnings from samples that do not exclude individuals whose workweeks were between 20 and 34 hours.

19. The $1 cut-off in 1973 was chosen to eliminate individuals who were likely to have made severe errors in reporting their weekly earnings or hours. Subsequent cut-offs were chosen to correspond closely to actual increases in private average hourly earnings, which rose to ratios of 1.44, 2.17 and 2.62 on a 1973 base of 1.

20. That this increase lies between the changes in the 90-10 and 75-25 earnings differentials between 1970 and 1988 reported by Juhn et al (1993, p. 424) suggests the samples used here do not select out workers in a nonrandom way that might affect the results.

21. In these two later samples wage information is only available for one-fourth of the observations. In the earlier two samples nearly all observations had such information. Data from 1985 and 1991 by occupation were combined by taking weighted averages of the means of the D_{ts} in the upper (lower) half of the wage distribution in each sample.

22. There was a significant increase (from .756 to .770) in the Top 8 concentration ratio of work timing over this period, with the increase also continuing from the 1985 ratio of .764.

23. The estimated θ_t differ little if the indicators for industry are deleted from the regressions.

24. Every five years beginning in 1975 a Dutch time-diary study has been conducted, the Nederlands Tijdbestedingsonderzoek. I obtained these data and tried to study them to provide another examination of the phenomena, and test of the explanations, proposed here. The surveys regrettably never included information on the rspondents' earnings. Also regrettably, the number of respondents was sufficiently small that, coupled with the much lower incidence of evening and night work in Northern Europe than in the United States (see Hamermesh, 1996), we cannot even draw any conclusions about trends in work timing, much less about changes in its distribution.