# Changing inequality in work injuries and work timing

A new study suggests that, over the past 20 years, the burdens of working at undesirable times—evenings and nights—and the risk of occupational injury have increasingly been borne by lower-wage workers

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he most striking development in the U.S. labor market over the last 20 years has been the rapid rise in the inequality of earnings. Whether we measure hourly, weekly, or annual earnings-whether across individuals or across industries-or even whether we separate workers by education or experience level, we observe the same growing inequality of the immediate direct monetary returns to work.1 This is important, but the returns to most American workers' efforts are far broader than what these direct measures encompass. They include employers' contributions to pensions and to their employees' health care, as well as less important payments, such as for educational expenses, workers' compensation, and so on.<sup>2</sup>

There is yet a third category of benefits that workers receive from their jobs-the nonmoney characteristics of work that distinguish what we like to call "good jobs" from "bad jobs." These include the jobs' dangers, their unpleasantness (dirtiness, repetitiousness, and so forth), and perhaps even the esteem in which they are held. While the monetary value of this kind of benefit from work is difficult to measure, the returns are real. Most important, in at least two cases-the incidence of evening and night work, and the burden of injuries on the job-we can measure how these returns are distributed and how their distribution has changed in the United States, and we can compare these changes to the distribution of earnings. The result is an expanded view of changing inequality in the U.S. labor market over the past 25 years. This broader approach is made

possible because BLS has recently updated its information on the timing of work, and because consistent series on occupational injuries have now been available for nearly 20 years.

#### What we expect

It is easy to see how changes in amenities are altered when the earnings capacities of workers in different groups change. View workers as being able to obtain a combination of earnings, other monetary benefits, and nonmoney benefits from the jobs they occupy. They sort themselves among jobs that differ by the amenities that the jobs offer, according to their preferences for amenities and earnings. Workers who especially like amenities (for example, workers who are extremely averse to being injured on the job, or who cannot stand working at night) will sort into jobs that avoid those disamenities. Jobs that fail to offer amenities will have to compensate incumbents for their absence. We will observe that otherwise identical workers obtain higher wages in those jobs, so that the jobs may be viewed as offering premium wages.<sup>3</sup> Because workers whose overall earnings ability is low require earnings just to get by, they will be especially willing to accept unpleasant jobs that compensate for the unpleasantness by offering higher wages.

Over the last 20 years, whether because of increased international trade, technical change that is biased toward skilled workers, declines in institutions that protect low-skilled workers, or still

Daniel S. Hamermesh is Centennial Professor of Economics, University of Texas at Austin, and research associate, National Bureau of Economic Research. other causes, shocks to the labor market have raised the earnings ability of skilled workers relative to unskilled workers. This relative improvement in the prospects of those who would have earned more anyway should have caused them, even more than before, to shy away from jobs that lack workplace amenities. Conversely, low-skilled workers would be observed occupying an even greater fraction of the jobs that have undesirable characteristics: because the supply of skilled workers to those jobs is reduced, the jobs should be offering higher wage premiums; and, with their earnings ability not improving, lower-skilled workers would find the premiums more attractive than before. Changes in the distribution of workplace amenities would mirror changes in the distribution of wages. The widening distribution of earnings is likely to have been accompanied by an increasingly unequal distribution of the burden of unpleasant workplace characteristics.<sup>4</sup> Only if employers have found it especially easier to reduce injury risks or to offer daytime jobs for low-skilled workers will these predictions not have been borne out during the past two decades of rising earnings inequality.

## Inequality of work timing

Table 1.

Beginning in 1973, BLS fielded the May Work Schedules Supplement to the Current Population Survey (CPS).<sup>5</sup> From 1973 to 1978, and again in 1985, 1991 and 1997, each worker responding to the survey was asked questions like, "At what time of day did ... begin (end) work on this job most days last week?"<sup>6</sup> From the information that the respondents provided, we can construct a set of 24 indicators,  $L_{ia}$ , for each worker *i*  interviewed in year *t*, with the indicator equaling 1 if the responses imply that the person worked in the market at hour *s*, 0 if not. This is different from identifying workers as being on shifts, as has been done in other studies appearing in the *Monthly Labor Review*.<sup>7</sup> Because a majority of workers at work at, for example, 3 a.m. would not be classified as night-shift workers, this hour-by-hour approach gives a fuller picture of the distribution of work.<sup>8</sup> By relating the sequences  $L_{ist}$  to workers' weekly earnings and to their demographic characteristics, we can examine how the timing of work is distributed across the labor force, and how changes in its distribution are related to changes in the distribution of earnings. The CPS Supplements for 1973, 1978, 1985, 1991, and 1997 provide a quarter-century of measures of this distribution, at roughly even intervals.

Before examining how the distribution has changed, we need to establish whether there is, in fact, a consistent pattern relating work at various times of the day to the workers' demographic characteristics. To save space, I define the variables EVE = 1 if the worker was on the job at any time between 7 p.m. and 10 p.m., 0 otherwise, and NIGHT = 1 if he or she was on the job at any time between 10 p.m. and 6 a.m., 0 otherwise. I relate these variables to workers' educational attainment, their age, race or ethnic status, and other controls available in the CPS. In addition, in the some of the estimates, I hold constant for the workers' detailed industry affiliation (thus controlling for potential differences caused by the employers', rather than the workers', behavior).

Table 1 presents the coefficients from linear-probability estimates of the determinants of EVE and NIGHT for all workers in the May 1997 Supplement whose usual weekly

[Standard errors in parentheses]								
	Men				Women			
Characteristic <sup>1</sup>	Evening		Night		Evening		Night	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High school graduate	036 (.009)	027 (.008)	.004	001	123 (.009)	085 (.009)	046 (.007)	023
Some college	022	023	004	012	123	076	055	028
College degree	082	080	089 (.008)	086	159 (.009)	096 (.010)	095 (.007)	062
Age	023	017 (.001)	005	005	024 (.001)	020 (.001	006	006 (.001)
Age <sup>2</sup> /100	.024 (.001)	.018 (.001)	.005	.005	.025	.021 (.001)	.006	.006 (.001)
African-American	.032 (.010)	.012 (.009)	.053 (.008)	.021 (.008)	.023 (.008)	.024 (.007)	.033 (.006)	.026 (.006)
Hispanic	.003 (.009)	005 (.009)	.004 (.008)	001 (.008)	009 (.009)	001 (.009)	.008 (.007)	.009 (.007)
Industry controls:	No	Yes	No	Yes	No	Yes	No	Yes
R <sup>2</sup>	.140	.232	.130	.215	.148	.217	.206	.247
Number of observations	19,520				17,402			
<sup>1</sup> The equations also control for marital status, geographic location, and total hours worked.								

Regression estimates of the determinants of evening and night work, May 1997 CPS



hours were 35 or more. Because women's and men's work timing differ, the estimates are presented separately by sex. For both EVE and NIGHT, the first column in each pair presents estimates that exclude industry indicators, while the second includes them. The results make it very clear that evening or night work disproportionately burdens those with lower educational attainment (the excluded category is workers with less than a high-school diploma). Because education yields labor-market returns, this means that workers with less ability to generate earnings are more likely to work at these times. Similarly, the U-shaped relationship between age and the incidence of evening or night work shows that such labor is disproportionately done by younger workers or by those nearing retirement. Holding constant their total work hours, the lowest probability of work outside the standard workday is among workers around age 50. As the estimates based on equations that include industry indicators show, this negative relationship between the probability of working evening or night and a worker's earnings ability is changed only slightly even when we account for the worker's detailed industry affiliation.

The estimates in table 1 also provide some evidence that evening and night work is done disproportionately by minorities, especially by African-Americans, even after accounting for racial or ethnic differences in age and educational attainment. There are essentially no differences in the probabilities of evening and night work between non-Hispanic whites (the excluded category) and Hispanics. The differences in the probabilities of working evenings or nights are consistent with the notion that workers whom the labor market rewards less, be it because of differences in human capital or labor-market discrimination, are more likely to work evenings or nights. By inference, those are undesirable times to work evening or night work is a disamenity.

Having shown that workers with lower earnings potential have a greater likelihood of performing evening or night work, we can examine how patterns of work timing have changed in relation to changing earnings differences. As in the literature on earnings inequality, I base the comparisons on the weekly earnings of full-time workers, that is, those working 35 hours per week or more. To verify that the earnings of full-time workers in these May CPS Supplements exhibit the same rise in inequality that has been noted more generally, chart 1 presents estimates of

(1)  $D^2 W_t^q = [W_t^q - W_t^4] - [W_{73}^q - W_{73}^4], q = 1, 2, 3,$ 

where *W* is the logarithm of average weekly earnings among workers in earnings quartile *q* in year *t*, and the superscript 4 refers to workers in the bottom quartile of earnings.<sup>9</sup> The measures  $D^2 W_t^q$  for men and women thus show percentage changes in average earnings within each of the three upper quartiles since 1973 compared to changes in earnings in the lowest quartile. The results parallel what has been demonstrated generally: for both men and women, there has been a very sharp rise in earnings inequality since the early 1970s, with much of the increase coming between 1978 and 1985. The biggest increases have been in the top earnings quartile, and those increases continued between 1991 and 1997 for workers of both sexes in that earnings quartile.<sup>10</sup>

I sorted the data by weekly earnings and calculated, for each worker, the fraction of his or her total workday accounted for by work at each hour *s*. These data were then averaged to give  $F_{st}^{q}$ , the fraction of work by those in the *q*th quartile in year *t* that was performed at hour *s*. The measures *F* show the intensity of work at each hour by the average full-time worker in the earnings quartile. Relative changes since 1973, and thus in the burden of work at each hour of the day, can be summarized by the differences

(2) 
$$D^2 F_{st}^{\ q} = [F_{st}^{\ q} / F_{st}^{\ 4}] - [F_{s73}^{\ q} / F_{s73}^{\ 4}],$$

calculated as ratios to allow for convenient presentation. A ratio below 1 implies that workers in quartile q performed a smaller fraction of their total hours of work at that hour s than did workers in the lowest earnings quartile. A negative difference means that, after 1973, workers in quartile q became even less likely than workers in the bottom earnings quartile to work at time s.

Chart 2 shows these interquartile differences for men, comparing workers in the top and bottom quartiles of earnings at each hour of the day. Chart 3 presents the same information for women. While the differences are small for 1978, they begin to depart from 0 in the data for 1985. In particular, there is a general, albeit not steady, decrease in the differences in the evening and night hours for both men and women. The negative values of  $D^2 F_{st}^{\ q}$  between 8 p.m. and 5 a.m. show that the relative burden of evening and night work was increasingly borne over this quarter-century by workers in the bottom quartile of the earnings distribution.

The negative values of  $D^2 F_{st}^q$  between 8 p.m. and 5 a.m. must be offset by positive values at other times. These offsets occur especially at the fringes of the "normal" workday. Implicitly, higher-wage workers, whose total workhours have been increasing, have been spreading their workdays to early morning and late afternoon, at the same time that they have been cutting back from working in the evenings and at night (at least compared to lower-wage workers).<sup>11</sup> The double-differences for 1997 are quite similar for men and women, but the decline in evening or night work and the rise in work at the edges of the regular workday do not exhibit the same steady trend among women that they do among men.

We have seen that there has been a relative decline in work at undesirable times of the day—evenings and nights among precisely those workers whose earnings have risen relatively. To examine the strength of this relationship—how



great a change in the incidence of evening and night work has been associated with given changes in relative earnings—I estimate the simple regressions

(3) 
$$L_{stq} - L_{st4} = \text{Constant} + b[W_t^q - W_t^4].$$

Included in them also is a pair of indicator variables for quartiles 1 and 2. Each regression includes 15 observations, pooling three differences for each of the years 1973, 1978, ..., 1997, and each is estimated over each hour *s*, for men and women separately. They indicate a relationship between changes in earnings and changes in work timing, not causation: both work timing and earnings are outcomes that are generated by a combination of workplace technologies and workers' earnings capacities and preferences.

The estimates of the slope parameters in (3) are shown for selected hours *s* in table 2. They make it fairly clear that, as interquartile earnings differences have increased, probabilities of working at odd hours relative to those of workers in the lowest earnings quartiles have decreased. This is especially apparent for men (among whom interquartile earnings differences rose more rapidly than among women). Obversely, the relative probabilities of working during regular daytime hours have increased along with increases in interquartile differences in earnings.

The comparisons show clearly that widening earnings inequality has been associated with lower-wage workers bearing an increasing share of the burden of work at these times. I have explained this in terms of workers' choices of jobs and occupations. One might instead argue that it has gotten relatively easier for employers to schedule higher-skilled workers' jobs outside of evenings and nights. This explanation is inconsistent with the common observation that it is higher-paid managerial and clerical workers who must work unusual hours to remain part of the Internet-wired global economy. It also is inconsistent with the facts: charts like charts 2 and 3, but calculated for managerial and clerical workers alone, show the same increasing relative burden of evening or night work on low-wage workers as do charts based only on blue-collar workers.<sup>12</sup>

### Inequality in risk of injury

Since the passage of the Occupational Safety and Health Act of 1970, BLS has developed a consistent set of establishment-based measures of the incidence of occupational injury—the number of lost-workday incidents per 100 employees. By the late 1970s, this data program had matured, so that consistently defined series on the incidence of injury now are available for most detailed industries for nearly two decades. In the comparisons here, I use data covering 1979–97. While we know that the incidence of injuries was essentially constant during most of this period, changes in its industrial distribution have not been analyzed.<sup>13</sup>

BLS injury data are collected by establishments and grouped

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The relation between interquartile differences in the fraction of work and interquartile differences in earnings, May cPs 1973–97

[Standard errors in parentheses]							
	Men	Women					
Hour of the day at work	(1)	(2)					
Midnight	105	071					
3 a.m	062	033					
6 a.m	(.021) 014	.016					
9 a.m	(.036) .334	.085					
Noon	(.083) .241	(.042) .209					
3 p.m	(.059) .357	(.061) .188					
6 p.m	(.106) 089	(.068) .081					
9 p.m	(.046) 221	(.060) 069					
	(.037)	(.036)					

by SIC industry classification, which has changed during this period. Because I wish to use earnings data from the house-hold-based Outgoing Rotation Groups of the CPS, and those data are classified by the Census industrial codes, it is necessary to create a concordance between the two sets of industry definitions. To solve these difficulties, I created a set of 3- and 4-digit SIC industries that are defined consistently and identically over this period in the SIC and Census classifications. This balanced 19-year panel of 129 industries covers roughly 75 percent of all private nonfarm employment and provides the best balance between the competing goals of coverage and consistency. For each year, it contains an establishment-based measure of injury incidence, and it measures weekly earnings in the industry as a weighted (by hours worked) average of a random sample of workers in the industry.<sup>14</sup>

While we know that earnings inequality across individuals rose between the late 1970s and 1997, there is no evidence on inequality of earnings across American industries for this period.<sup>15</sup> To demonstrate trends in earnings inequality at the industry level, I calculate differences in the logarithms of quartile average weekly earnings for each year from 1979 to 1997 as

## (4) $DW_t^q = [W_t^q - W_t^4],$

based on the 129 industries arrayed by earnings. (Each quartile except the second is defined to contain 32 industries.) The same industry may be in different quartiles of the earnings distribution in different years, although the relative constancy of wage differences across industries ensures that changes in the composition of earnings quartiles are slow and typically minor. These differences are presented for the years 1979–97 in chart 4. They show roughly 10-percentage-point



rises from 1979 to 1995 in the differences in earnings between the top and bottom quartiles, and the second and bottom quartiles, and a smaller increase between the third and bottom quartiles. Interestingly, there is some evidence that relative wages in the lowest-paying quartile of industries rose by several percentage points relative to other industries after 1995, perhaps reflecting the same, possibly cyclical changes that are observed in CPS data for 1996 and 1997.<sup>16</sup>

For each year, I array the industries by average earnings and calculate the average incidence of industrial injuries for each earnings quartile. Differences in incidence rates between industries in each of the top three earnings quartiles and those in the bottom quartile are shown in chart 5. In 1979, the lowest-paying quartile of industries had a lower relative incidence of injuries than the other industries, especially those in the second and third quartiles. This shows that it is not just workers' earnings potential, but also technology that affects the distribution of the burden of injuries at a point in time. The data demonstrate that there was a startling change in the burden of injury risks by industry (which averaged 4.38 per 100 employees in this sample over 1979-97). Between 1979 and 1995, the incidence of injuries fell by 1 per 100 in the top quartile relative to the bottom quartile. It fell by 1.5 per 100 in the second quartile and by around 0.5 per 100 in the third quartile (in which wages had not risen relatively as much) relative to the bottom earnings quartile. Remarkably, in 1997, after 2 years in which earnings relative to the lowest-paying industries had fallen slightly, the incidence of injuries in the upper three quartiles rose, perhaps beginning a reversal of the previous 17 years of widening inequality of both earnings and injury risks.

To examine the relationship between changes in earnings and changes in the risk of injury across industries, I estimate an equation like (3). Here each observation is one of the top three earnings quartiles for a year between 1979 and 1997. As in equation (3), the estimates show a relationship between two outcomes that is generated by a complex process of matching workers and firms, one that is affected by workers' changing earnings capacity and companies' changing technologies. The regression equation is

(3') 
$$[INC_q - INC_4]_t = Constant - 14.16[W_q - W_4]_t,$$
  
(2.29)  
 $q = 1, 2, 3; t = 1979,...,1997$ 

where INC is the incidence of injury and the standard error is below the parameter estimate. The regression also includes dummy variables for the top two quartiles. The significant negative coefficient shows that changes in interindustry earnings inequality over this period were associated with a significant drop in injury risk in those quartiles where earnings rose relatively. The roughly 10-percent rise in relative earnings of the top over the bottom quartile was contemporaneous with a roughly 1.5 per 100 employee relative drop in lost workday injuries.

One might worry here, too, that the findings confound workers' choices with what we know to be major changes in technology and the structure of work during the 1980s and 1990s. The impacts of these changes surely differ across industries, and perhaps interindustry changes in injury risks merely reflect slow changes in the composition of the earnings quartiles. To adjust for this possibility, I define the earnings quartiles based on the industries' average earnings over the 19-year period. Thus, the composition of the bottom quartile, for example, is identical in all 19 years and includes those 32 industries whose workers had the lowest average earnings over this entire period. Chart 6 is identical to chart 5, except that the differences in injury incidence are based on an unchanging definition of the quartiles of industries ranked by average earnings. The chart shows that this redefinition produces only minor changes: The incidence of injury falls in the top three quartiles relative to the bottom between 1979 and 1995 (with the biggest decline being in the top quartile, where relative wages rose most); and the hint of a reversal of these trends after 1995 is present here, too.<sup>17</sup>

OVER THE LAST 20 YEARS, THE BURDENS of working at undesirable times—evenings and nights— and the risk of occupational injury have increasingly been borne by lower-wage workers. The same forces that have generated widening earnings inequality have produced greater inequality in the distribution of the nonmoney returns to work. The fundamental cause of greater labor-market inequality in the United States is a subject of intense debate. What should no longer be debatable is that this increase in inequality is more widespread than in the readily measured and much studied earnings measures: it also is reflected in statistics describing two measures of the amenities that yield important additional returns to workers. As such, the results here imply that focusing solely on changes in earnings understates the extent of the rise in labor-market inequality that has occurred in the past two decades.

The analysis of labor-market inequality in other economies, and thus comparisons to changing inequality in the United States, would be enhanced by extending it to include the study of changing inequality in the distribution of workplace amenities. There also are other amenities on which consistent data might be found for the United States over a period long enough to permit analyses similar to those presented here. Most important, the series used here are available on a regular basis, so that the study can be updated easily. It should thus be possible to generate consistent series of broader measures of labor-market inequality to match the measures of earnings inequality that are increasingly available on a regularly updated basis.<sup>18</sup>

## Notes

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<sup>1</sup> This has been demonstrated by many authors, including Chinhui Juhn, Kevin M. Murphy, and Brooks Pierce, "Wage Inequality and the Rise in Returns to Skill," *Journal of Political Economy*, June 1993, pp. 410–42: and Sheldon Danziger and Peter Gottschalk, eds., *Uneven Tides: Rising Inequality in America* (New York, Russell Sage Foundation, 1993).

<sup>2</sup> Changes in the distribution of health and pension payments are reported on by Brooks Pierce, "Compensation Inequality," BLS Working Paper (Bureau of Labor Statistics, April 1998).

<sup>3</sup> The theory behind the allocation of amenities and the premiums attached to disamenities is presented in Sherwin Rosen, "Hedonic Prices and Implicit Markets," *Journal of Political Economy*, January/February 1974, pp. 34–55. Such premiums have been demonstrated for the risk of death on the job by Richard Thaler and Sherwin Rosen, "The Value of Saving a Life: Evidence from the Labor Market," in Nestor Terleckyj, ed., *Household Production and Consumption* (New York, Columbia University Press, 1976); for injuries by, among others, Daniel Hamermesh and John Wolfe, "Compensating Wage Differentials and the Duration of Wage Loss," *Journal of Labor Economics*, pt. 2, January 1990, pp. S175–S197; and for evening and night work, by Peter Kostiuk, "Compensating Differentials for Shift Work," *Journal of Political Economy*, October 1990, pp. 1054–75.

<sup>4</sup> I present the economic theory underlying these arguments in my study, "Changing Inequality in Markets for Workplace Amenities," *Quarterly Journal of Economics*, November 1999, pp. 1085–124. That study also includes other applications and demonstrates how the secular changes can be used to infer structural parameters.

<sup>5</sup> The Current Population Survey is a monthly survey of approximately 50,000 households selected to represent the U.S. population aged 16 and older. It is conducted by the Bureau of the Census under contract to the Bureau of Labor Statistics.

<sup>6</sup> From 1985 on the initial and final clauses in the question were reversed.

<sup>7</sup> Earl Mellor, "Shift Work and Flexible Time: How Prevalent Are They?" *Monthly Labor Review*, November 1986, pp. 14–21.

8 See Daniel Hamermesh, Workdays, Workhours and Work Sched-

ules. (Kalamazoo, MI, W.E. Upjohn Institute, 1996), table 3.1U.

<sup>9</sup> Earnings data in the CPs are top-coded, that is, earnings above a specified level are reported only as being at or above that level (for example, "\$75,000 or more per year"). For purposes of this study, I multiply top-coded earnings by 1.5, as is common in this literature.

<sup>10</sup> All the calculations in this section also were made comparing workers in the top and bottom deciles. The conclusions are qualitatively identical to those in the text.

<sup>11</sup> Evidence on the relative increase in high-skilled workers' labor supply during this period of rising earnings inequality is provided by Chinhui Juhn, Kevin M. Murphy, and Robert Topel, "Why Has the Natural Rate of Unemployment Increased over Time?" *Brookings Papers on Economic Activity*, fall 1991, pp. 75–142.

<sup>12</sup> Daniel Hamermesh, "The Timing of Work over Time," *Economic Journal*, January 1999, figure 8, presents charts like this comparing 1991 and 1973.

<sup>13</sup> Bureau of Labor Statistics, *Report on the American Workforce, 1994*. (Washington, U.S. Department of Labor, 1994).

<sup>14</sup>This new panel is available from the author upon request.

<sup>15</sup> We do know from Linda Bell and Richard Freeman, "The Causes of Rising Interindustry Wage Dispersion in the United States," *Industrial and Labor Relations Review*, January 1991, pp. 275–87, that earnings inequality across industries was rising from 1979 to 1987.

<sup>16</sup> Finis Welch, "Industrial Change and the Demand for Skill," Unpublished paper (Texas A&M University, March 1999), figure 1.

<sup>17</sup>A final concern is that charts 4 through 6 treat each industry identically, even though the industries may differ greatly in size. To examine whether this treatment affects the findings, I redefine the earnings quartiles by arraying industries by average weekly earnings from bottom to top, and then including in the bottom quartile the lowest-paying industries accounting for 25 percent of total employment, in the third quartile the next set of industries accounting for 25 percent of employment, and so forth. Recalculations based on this redefinition do not change the conclusions: the charts look very similar to those presented here.

<sup>18</sup> For example, see Organization for Economic Cooperation and Development, *Employment Outlook, July 1996* (Paris, Organization for Economic Cooperation and Development, 1996), ch. 3.