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Briefing Paper

# Bad Times: The Impact of Changes in Work Schedules on Productivity Growth

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November 2004

We are grateful to the Rockefeller Foundation for generous support of this project. We thank Paul Swaim for his helpful technical assistance with the hours data.

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**Executive Summary**

Economists generally view productivity – output per hour of work – as the most important determinant of economic well-being. However, the standard measures of output are seriously flawed since they treat all hours as identical, regardless of when the hours are worked. Specifically, productivity measures do not distinguish between overtime hours, night and weekend hours, or erratic hours scheduled at the discretion of the employer, on the one hand, and regularly scheduled hours worked during the standard workweek, on the other.

The distinction between standard and nonstandard work hours is important for accurate productivity accounting, since the benefits from working these "bad hours" will appear on the output side of the equation. For example, an employer that can freely require overtime work, should be able to produce more output than an employer who must schedule hours well in advance. Similarly, items sold at 24-hour convenience stores sell for higher prices (which is reflected in GDP) than items sold in standard supermarkets.

Therefore, economists should want to distinguish between gains in output per hour that are attributable to more output from the same type of hours worked, and gains in output that are due to workers working less desirable hours. This paper is a preliminary effort at quantifying the amount of hours worked outside of the standard workweek. Using data from the May 2001 Work Schedule supplement to the Current Population Survey, we find:

- Seven percent of workers usually work at least six days per week. In addition, 17 percent usually work on Saturdays and nine percent usually work on Sundays.
- Almost 18 percent of workers work some kind of nonstandard shift. Evening shifts are the most common (6.9 percent), followed by irregular shifts (3.9 percent), night shifts (3.1 percent), and rotating shifts (2.4 percent).
- A large share of the working population starts or finishes work outside of the standard 8am to 6pm work day. Just under 44 percent of workers start work before 8am, and almost 21 percent finish work after 6pm.
- In total, at least 15 percent of all hours worked fall outside the standard workweek.

The large quantity of nonstandard hours could have a substantial impact on how economists view the performance of the US economy, both through time and in comparison with other countries. While further research is needed to determine the appropriate size of adjustment for nonstandard hours (which would differ for different types of hours), simple calculations suggest that an adjustment could lower measured productivity in the United States by as much as 10 percent.

If the percentage of nonstandard hours has increased rapidly in recent years, then this would suggest a different view of the recent productivity upturn. Similarly, if non-standard hours prove to be far more common in the US economy than they are in other rich countries, the United States may rank lower in international productivity comparisons than current data indicate.

While the findings of this paper show the non-standard hours account for a substantial percentage of all hours worked, further research will be necessary to determine the growth path over time, and to have a reliable measures for international comparisons.

Economists generally view productivity as the single most important measure of economic well-being. Productivity is defined as the average value of goods and services (measured in dollars) produced in one hour of work. The need to control for changes in the quality of goods and services –the denominator in the productivity measure– has long complicated attempts to measure productivity, especially, the growth rate of productivity over time. A new-fangled coffee-maker, for example, may cost more than an old-fashioned stove-top percolator, but the new coffee-maker can make espresso and steam the milk. Airline travel, on the other hand, may cost less today than it did twenty years ago, but seating is more cramped and flights no longer come with a meal. Economists have extensively debated the implications of such changes in the quality of output for the measurement of output and productivity, most recently, in connection with the possibility that the Consumer Price Index may overstate the true rate of inflation by not taking fully into account improvements in the quality of new goods and services.[2]

By contrast, economists have paid almost no attention to measuring the "quality" of the hours worked to produce the output –the numerator in the productivity measure. Few workers or economists would argue that hours worked at nonstandard times such as nights and weekends are qualitatively identical to hours worked between Monday and Friday from 9am to 5pm. Yet, our standard productivity measure treats all hours – including those worked at night and on weekends, or after eight hours in one day or forty hours in one week, or on the sixth and seventh day of a work week– as identical.

Failure to control for the type of hours worked could have an important impact on our interpretation of changes in productivity over time or differences in productivity levels across countries. For example, if output per rises in a country because workers are forced to work at less desirable times, such as weekends or evening shifts, then these output gains do not represent an increase in economic well-being.

Such changes in hours (or a loss of control over work schedules by workers) may, in fact, be an important factor explaining at least part of recent increases in measured output per hour. Employers (and economists) routinely argue that workplace flexibility – meaning less rigid work hours – is essential for maintaining profitability. At the most basic level, services provided at unusual times –for example, food sold at 24 hour convenience store– command a premium price. Our current measures of productivity pick up any increases in output that results from workers losing control over their work time or putting in less desirable hours.

However, our current procedures make no adjustment on the input side for less desirable hours. From a social perspective, productivity growth that simply reflects the use of a fixed amount of capital during longer shifts, nights, and weekends is less desirable than a rise in productivity produced by technological advances or better training. It is important to realize that this issue is simply one of accurate measurement, not an ethical question about the proper treatment of workers. The analysis is not affected in any way if workers

2 See Lebow, D. and Jeremy B. Rudd, 2003. "Measurement Error in the Consumer Price Index: Where Do We Stand?" *Journal of Economic Literature*, VXLI pp159-202 and Baker. D. 1997. *Getting Prices Right: The Debate Over the Accuracy of the Consumer Price Index*. Armonk, NY: M.E. Sharpe.

receive premium pay for working extra hours or at inconvenient times. The point is to distinguish between a gain in output for the same type of hour – presumably due to more capital or better workplace organization – and a gain attributable to less desirable (and more valuable) hours.

In this brief analysis, we assess the potential quantitative impact of factoring the "quality" of work hours into standard measures of productivity. First, we use data from the May 2001 Work Schedule supplement to the Current Population Survey to calculate a simple and almost certainly conservative estimate of the volume of total nonstandard hours as a share of total hours worked. We then use plausible estimates of the "premium" that workers need in order to compensate for working nonstandard hours to produce a rough but reasonable estimate of the impact on measured productivity. We conclude with a discussion of the implications of our analysis for the measurement of productivity growth over time and for international comparisons of productivity levels.

**Estimating hours of nonstandard work**

The May 2001 Current Population Survey (CPS), a large, nationally representative survey conducted by the Census Bureau, included a special supplement that asked workers detailed questions about their usual work schedule. These data from the CPS Work Schedule supplement allow us to distinguish between hours worked during the course of the regular work week, defined here as between 8am and 6pm, Monday through Friday, and hours worked at other times, specifically, evenings, nights, and weekends. We can use the resulting estimates of standard and nonstandard work hours to produce an estimate of the share of all hours worked outside of regular work hours.

A few examples will illustrate the general procedure we used to estimate the share of nonstandard hours of work.

- If a worker usually starts work at 9am and usually finishes work at 5pm and usually works only Monday through Friday, we calculate the total number of hours worked per week as 40 hours: eight hours per day times five days per week.[3] Since all of these hours fall between 8am and 6pm, Monday through Friday, in this case, the total number of nonstandard work hours would be zero.

- If a worker usually starts at 6am and works until noon, Monday through Thursday, we would calculate total hours worked per week as 24: six hours per day times four days per week. Since two hours each day are before 8am, we would calculate usual nonstandard work hours as eight: two hours per day times four days per week. The resulting share of nonstandard work hours would be 33 percent (8 nonstandard hours / 24 total hours).

- If a worker usually works from 8am to 6pm, Friday through Monday, his or her total hours per week would be 40: ten hours per day times four days per week. Since all of the hours on fall between 8am and 6pm, none of these hours on Friday and Monday would count as nonstandard. However, since we count all hours worked on Saturday

3 Note that the CPS Work Schedule data do not allow us to distinguish between hours on the job and actual hours worked (hours on the job, minus breaks and periods not working).

and Sunday as nonstandard, the total number of nonstandard hours would be 20: ten hours per day on Saturday and Sunday. The final share of nonstandard hours would be 50 percent (20 nonstandard hours / 40 total hours).

- If a worker usually works midnight to 8am, Monday through Friday, total hours per week would be 40: eight hours per day times five days per week. Total nonstandard hours would also be 40, since all hours worked fall outside the 8am to 6pm period on Monday to Friday. In this final example, the share of nonstandard hours would be 100 percent (40 nonstandard hours / 40 total hours).[4]

This procedure provides the best estimate of nonstandard work hours possible, given the format of the CPS Work Schedule supplement. The procedure, however, most probably underestimates the share of nonstandard work hours, making our calculations below conservative estimates of the effect of adjustments on measured productivity. Our estimates of nonstandard work hours are low for three principal reasons. First, we have excluded any overtime hours worked during the standard Monday through Friday, 8am to 6pm period. If a worker works Monday through Friday from 8am to 6pm, he or she is on the job 50 hours per week, ten of which are in excess of the standard 40-hour week. Ten of the 50 hours, therefore, could conceivably count as nonstandard hours by a reasonable definition.

Second, the 2001 CPS Work Schedule supplement asked workers only about their *usual* schedule. To the extent that workers regularly or even occasionally deviate from their usual schedule and these deviations involve working outside the standard work hours, the total number of nonstandard hours worked in a year would be higher than our estimate here.[5] Finally, our analysis measures only the standard and nonstandard hours at the respondent's main job. We have therefore excluded both standard and nonstandard hours at second (and additional) jobs. To the extent that second jobs are more likely to involve working at nonstandard times such as evenings and weekends, excluding second jobs from our analysis probably further reduces our estimated share of nonstandard hours. All three of these factors mean that our estimates below of the effect of nonstandard-work-hour adjustments on productivity are likely to understate the true effect.

Table 1 summarizes the available data from the May 2001 CPS Work Schedule supplement. According to the CPS data, a substantial portion of workers have schedules that include at least some nonstandard hours or shifts. About 7 percent of workers usually work six days per week, with almost 2 percent usually working seven days per week. About 17 percent of workers usually work Saturdays, and almost 9 percent usually work Sundays. Almost 18 percent of workers work some kind of nonstandard shift. Evening shifts are the most common (6.9 percent), followed by irregular shifts (3.9 percent), night shifts (3.1 percent), and rotating shifts (2.4 percent). A large share of the working population starts or finishes work outside of the standard 8am to 6pm work day. Just under 44 percent of workers start work before 8am, and almost 21 percent finish work after 6pm.

4 The computer programs used to classify standard and nonstandard hours are available upon request.

5 The 1991 and 1997 CPS Work Schedule supplements asked workers about their hours in the week prior to the survey.

**TABLE 1**
**Non-standard work hours, 2001**
(percent)

| | |
|---|---|
| Usually work six days per week | 6.6 |
| Usually work seven days per week | 1.7 |
| | |
| Usually work Saturdays | 17.0 |
| Usually work Sundays | 8.8 |
| | |
| Shift work | |
| Evenings | 6.9 |
| Nights | 3.1 |
| Rotating | 2.4 |
| Split | 0.5 |
| Irregular | 3.9 |
| Other | 0.7 |
| | |
| Enters work after 6pm and before 8am | 43.5 |
| Exits work after 6pm and before 8am | 20.7 |
| | |
| Estimated share of nonstandard hours in total hours worked per week | 15.3 |

Notes: Analysis of CEPR extract of CPS Work Schedule supplement, May 2001. Sample includes full-time and part-time employees; excludes the self- employed. Nonstandard hours defined as those worked after 6pm and before 8am, or at any time during the sixth or seventh day in a work week, or at any time during a Saturday or Sunday.

Taken together, the numbers in the table demonstrate that a substantial portion of the workforce, somewhere around half, have schedules that regularly involve working at least some nonstandard hours. However, since our principal interest is in productivity, we are not as interested in the share of *workers* with nonstandard hours as we are in the share of all *hours* worked that are nonstandard. The last line of Table 1 presents our estimate of the share of all hours worked that were nonstandard, following the procedure described earlier. According to our rough calculations, about 15 percent of all hours worked in 2001 fell outside the standard period from 8am to 6pm on Monday to Friday.

**Adjusting productivity for nonstandard work**

Table 2 presents some simple estimates of the impact of adjusting national productivity levels for nonstandard hours. The rows of the table correspond to different shares of nonstandard hours in total hours worked. The middle row assumes a 15 percent share of nonstandard hours, which is the estimate from Table 1 based on the CPS Work Schedule data. The first row assumes none of the hours worked are nonstandard, which is effectively what the current procedure for calculating productivity assumes. The last row

assumes that 20 percent of all hours are nonstandard, a plausible estimate of what nonstandard hours might include if we had included daily and weekly overtime during otherwise standard work hours, nonstandard work hours that are not part of workers usual schedule, and nonstandard hours worked in second jobs.

**TABLE 2**
**Adjusting productivity for non-standard work hours**

| Nonstandard hours as share of all hours | Penalty for nonstandard hours | | | | |
|---|---|---|---|---|---|
| | 0% | 10% | 30% | 50% | 100% |
| 0% | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 15% | 100.0 | 98.5 | 95.5 | 92.5 | 85.0 |
| 20% | 100.0 | 96.5 | 89.5 | 82.5 | 65.0 |

Notes: Authors' analysis. See text for complete explanation.

The most difficult aspect of adjusting productivity for nonstandard work hours is determining how to discount the nonstandard work hours to reflect the extra personal and social burden associated with the nonstandard work hours. One natural way to weight nonstandard hours would be to ask how much of a pay premium over workers' standard rate of pay is required to compensate them for the inconvenience of working at nonstandard times.[6] The columns of Table 2 assume different adjustment factors calculated along these lines. In the column marked ten percent, for example, we are assuming that a worker in a nonstandard job would need to receive a ten percent pay premium to compensate for the personal costs of a nonstandard hour of work. The adjustment factors in the table range from zero percent (effectively, the procedure followed by the current productivity definition) through 50 percent (equivalent to assuming a "time and a half" premium), through 100 percent (equivalent to "double time" for nonstandard work).

Once we've established the appropriate "premium" necessary for nonstandard hours, we can use the premium to adjust measured productivity for the inconvenience of working nonstandard hours. Imagine that an economy currently produces $1,000 of output in 100 hours worked over the course of a year. The productivity level would be $10 per hour. Now imagine that all of the hours were worked at nonstandard times and that workers required a ten percent premium to compensate them for nonstandard hours. The economy would still produce $1,000 per year, but rather than measuring hours as 100, we would measure them as 110 hours, reflecting the 10% premium workers' need to leave them just as well off working nonstandard hours as standard hours. The nonstandard-hours-adjusted level of productivity would fall from $1,000/100 hours or $10 per hour to $1,000/110 hours or $9.09 per hour. This simple procedure effectively penalizes the use of nonstandard hours when calculating productivity. The size of the penalty depends on

6 Such an approach would only take individual, private, costs of nonstandard hours into account. Social costs of nonstandard hours, such as, children deprived of parental attention on evenings or weekends, for example, would not be included.

how much workers dislike working nonstandard hours.

Each of the entries in Table 2 shows the effect on measured productivity of an analogous calculation under different sets of assumptions about the total number of nonstandard hours and the associated "penalty." The entry in the first row –zero percent nonstandard hours– and first column –no penalty for nonstandard hours– yields a productivity level set equal, for purposes of this example, to 100.0. The assumptions of zero nonstandard hours and zero penalty for nonstandard hours is, in effect, the procedure followed by current methods for calculating productivity. In the second row of the table –assuming 15 percent nonstandard hours (the estimate from Table 1)– and the second column –assuming a 10 percent discount for nonstandard hours– measured productivity would fall from 100.0 to 98.5. If workers need a 50 percent premium for nonstandard hours ("time and a half"), relative to the standard measure, adjusted productivity would fall 7.5 percent to 92.5.

Assuming a slightly higher share of nonstandard hours of 20 percent , and a nonstandard penalty of 30 percent, measured productivity would fall 10.5 percent to 89.5. With larger assumed penalties (up to 100 percent) measured productivity would drop even more.

The exercise in Table 2 suggests that adjusting measured productivity rates for plausible estimates of the volume of nonstandard hours and the associated welfare costs could significantly alter our productivity accounting. Assuming that nonstandard hours of work account for 15 to 20 percent of all hours worked and attaching a 10 to 30 percent penalty to those hours, would lower measured productivity by 1.5 to 10.5 percent.

**Policy implications**

The calculations summarized in Table 2 have important implications for two important public debates: the measurement of productivity growth over time and comparisons of productivity levels between the United States and other advanced, capitalist economies.

Economic booms tend to be periods when the average hours of work rise and productivity growth accelerates. To the extent that some portion of the expansion in hours over the business cycle reflects a rise in nonstandard hours, failure to properly discount the new, nonstandard hours would lead standard measures of productivity to overstate productivity growth during booms. Similarly, when the economy contracts, and nonstandard hours fall, the standard productivity measure may overstate any deceleration in productivity, relative to a measure that properly discounted nonstandard hours.

Moreover, to the extent that the US economy has over the last several decades moved toward greater use of more "flexible" (for employers) hours of work arrangements, our conventional measures of productivity may yield an overestimate of actual productivity growth, relative to a measure that controlled for the rise in less desirable hours.

Finally, to the extent that international perceptions of US workers as working longer and more flexible hours are true, comparisons of international productivity levels that don't take differences in nonstandard hours into account will systematically overstate the productivity of US workers relative to their counterparts in economies where nonstandard

work hours are less common. Given that differences in conventionally measured productivity levels are small, adjusting international productivity measures for nonstandard hours could significantly alter our rankings of international productivity levels. In 2002, for example, productivity levels were already higher in Belgium (111), western Germany (101), France (103), Ireland (103), Italy (105), the Netherlands (106), and Norway (131) than they were in the United States (set equal to 100), and productivity levels in Austria (96) and Denmark (95) were not far behind.[7] Controlling for nonstandard hours would shift these numbers in favor of countries working fewer nonstandard hours.

## Conclusion

More than 15 percent of all hours worked in the United States are worked during evenings, nights, weekends, and other nonstandard times An accurate measure of productivity should adjust for the type of hours worked, since increases in output per hour since output gains that stem from a loss of employee flexibility and other personal and social costs do not imply an increase in economic well-being.

Such adjustments are essential both for measuring economic progress through time and for accurately comparing economic well-being across countries. The simple set of calculations we present here suggests that accounting for the type of hours worked may substantially alter our understanding of economic progress over time and the relative productivity rankings of national economies.

7 See Lawrence Mishel, Jared Bernstein, and Sylvia Allegreto, *The State of Working America 2004-2005*, Table 7.3.

## Data Appendix

The Work Schedule (WS) supplement is a survey of work schedule and other issues administered periodically as part of the Bureau of the Census' Current Population Survey (CPS). The CPS is a monthly survey of 50,000 to 60,000 households (used for, among other purposes, to calculate the official unemployment rate). For more details on the CPS, see the CPS home page: http://www.bls.census.gov/cps/.

In May 2001, the WS supplement asks all employed and self-employed workers: the time they usually start and stop work; the number of days per week they usually work; which days of the week they usually work; the type of shift, if any, they usually work, and other detailed questions about their usual work schedule. For more details on the WS supplement, see: http://www.bls.census.gov/cps/worksch/worksch.htm.

All programs used to construct and analyze the data are available by request to jschmitt@cepr.net; the programs will also be available for downloading through CEPR's Data Resource Project (see http://www.ceprdata.org/).

## References

Mishel, Lawrence, Jared Bernstein, and Sylvia Allegreto, *The State of Working America 2004-2005*, Ithaca, NY: Cornell University Press, 2005.