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Article

Incentivizing sleep?

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World of Labor
Evidence-based policy making

Incentivizing sleep?

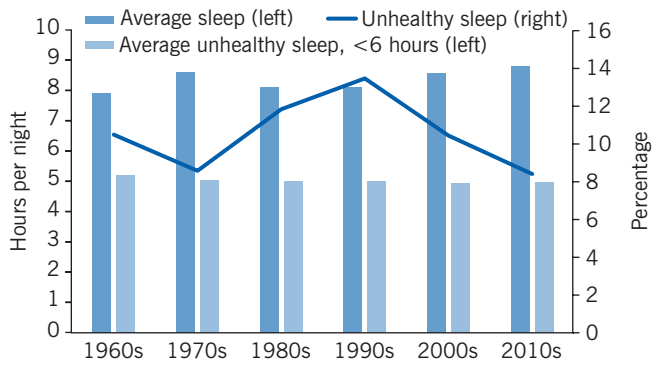
Insufficient sleep affects employment and productivity

Keywords: sleep, employment, productivity, employment regulation, monetary incentives, technology nudges

ELEVATOR PITCH

Spending time sleeping not only improves individuals' well-being, but it can influence employment outcomes and productivity. Sleep can be disrupted by company schedules and deadlines, extended working times, and several individual and household decisions. Labor market regulation and corporate strategies should factor in the immediate effect of insufficient sleep on employee fatigue and cognitive performance, and the associated effects on employment disruption and productivity loss. Sleep can be influenced by "sleep friendly" employment regulations, technology nudges, monetary incentives, and subsidies for sleeping.

Sleep time trends in the US, 1965–2017



Source: Various time-diary surveys, 1965–1999; American Time Use Survey, 2003–2017. 1960s avgs 1965–1966; 1970s avgs 1975–1976; 1980s = 1985; 1990s avgs 1992–1999; 2000s avgs 2000–2009; 2010s avgs 2010–2017.

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KEY FINDINGS

Pros

- Variable sleep can explain employment fatigue.
- Sleep deprivation can increase the probability of human error.
- Reduced sleep time has been shown to directly influence employment outcomes, productivity, and working times.
- Sleep deprivation gives rise to health effects such as burnout and anxiety, which have additional secondary economic consequences.
- Behavioral interventions such as bedtime reminders and monetary incentives can help generate more "productive" sleep.

Cons

- Individual sleep reports contain errors in how to measure sleep time and sleep quality, and especially in self-reported fatigue.
- Time diaries might increase the precision of sleep measures but do not measure sleep quality.
- Sleep time can be influenced by unforeseeable disruptions such as night temperature and sudden household events (e.g. children waking).
- The short- and long-term effects of reduced sleep on health and other outcomes are often not factored in when sacrificing sleep quality to attain immediate goals.
- Company-sponsored wellness programs do not always seriously prioritize sleep as a potential influence on employee productivity.

AUTHOR'S MAIN MESSAGE

Although individuals allocate a large amount of their time to sleep, typically eight to nine hours a day, sleep time is not considered as a determinant of economic performance and well-being. However, it is about time that labor market policy accounts for the role of sleep, given its effects on employment and productivity. Hence, both policymakers and corporations should consider designing policies and offering incentives to increase the time employees devote to sleep.

MOTIVATION

Devoting enough time to sleep is essential for optimal physical and psychological well-being. Sleep is typically the most time-consuming activity throughout a person's week [1]. Even though not all individuals need to sleep the same amount to feel rested, sleep time influences how the body recovers from a working day. However, sleep time often goes unaccounted for in economic models as an input directly influencing economic performance and is typically ignored as a key determinant of well-being, which might exert indirect effects on employment outcomes.

Evidence on sleep time trends in the US (which includes nap time) is displayed in the Illustration on p. 1. The average number of sleep hours displayed by the dark blue histogram bar suggests evidence of no major variation in the average hours individuals sleep on a daily basis. There is a jump after 2003 when the American Time Survey (ATUS) began to be used to measure sleep. However, the data before 2003 in ATUS do not distinguish sleep from sleeplessness in bed. Only 2% report sleeplessness of more than 15 minutes on the diary night, although the mean sleepless time among them is about 90 minutes. The standard deviation of sleep time across individuals has increased significantly, from 89 minutes in 1965 to 135 minutes in 2017. Furthermore, the continuous line plot in the Illustration on p. 1 indicates that between 8% and 13% of the population sleep less than six hours per night, which is defined as "unhealthy sleep." Individuals with unhealthy sleep patterns sleep an average of five hours (as reported in the light blue bars), again exhibiting no major changes over time. This is consistent with evidence of limited changes in working times (even though statutory working hours have significantly decreased in many European countries). Yet, there might still be significant differences in sleep quality, as 28% of Americans feel sleepy every day of the week, and 44% on at least two to four days every week [2].

The importance of sleep quality is clear in interpreting evidence from the Sleep in America Survey (SAS) [2]. Indeed, the SAS finds that only about half of individuals who feel sleepy attribute it to not having enough time to sleep (44%). The other half (55%) state that their sleepiness is due to "not sleeping well enough," which can result from environmental noise and other sleep disruptions referred to below. That said, sleep quality can be in part the result of individual daily and recurrent decisions, which are influenced by choices of bedtime, sleep routines, sleep environment and whether they fall prey to digital temptations, employment duties, diet, alcohol consumption, exercise time, exposure to different job and household stressors, as well as specific personality features such as the tendency of individuals to worry too much. Hence, a question that arises is: should policy incentivize employee sleep time and quality, and, if so, what interventions can be designed?

DISCUSSION OF PROS AND CONS

Seminal work on the economic analysis of sleep suggests that time in employment can exert an influence on sleep time. A classic estimate suggests that a one-hour increase in work time results in a 13-minute reduction in sleep [3]. Such models tend to assume that sleep is a choice; individuals trade off sleep time against other allocations of time, even though such trade-offs might change over time and will differ under different circumstances. Furthermore, sleep is found to predict wages by influencing labor market productivity [4]. However, the way in which the effect of sleep on wages is channeled is especially clear

in empirical studies among workers who are paid by the day, whilst the effects of sleep on productivity are not always reflected in earnings when wages are sticky—that is, when workers' earnings do not adjust quickly to changes in labor market conditions.

Based on empirical research it is possible to point out several influences on sleep time and quality, including the following:

Influences on sleep time and quality

Individuals' income

The impact of income on sleep is important, yet income effects are mainly driven by earned as opposed to unearned income [3]. In contrast, earned income gives rise to income as well as substitution effects. Sleep is substituted away for work with a higher opportunity cost in the form of higher wages, giving rise to a negative association between time devoted to sleep and income in the short term. However, additional income can allow investments in improving sleep, trading off sleep time for sleep quality.

Reliable information

The cost of sleep can vary over time, as the opportunity cost of work and leisure can vary over years, and even across seasons and time zones. Given the effect that sleep has on employment outcomes and health, some organizations have considered designing incentives to sleep. For instance, the insurance company Aetna offers $25 for every 20 nights in which individuals get seven hours or more of sleep, with a cap at $300 a year. Alternatively, some economic research suggests that subsidizing digital information devices to track sleep can play a role in time allocated to sleep. Evidence from a randomized control trial in a large employer population shows that paying a subsidy to employees to purchase a wearable wristband (to select and customize plans) was found to improve sleep and exercise [5]. Yet, although the trial documents effects on sleep time (1.2 to 3.6 additional minutes of sleep per night), no significant effects are found on sleep quality.

Business cycle

The opportunity cost of sleep can be influenced by the economic cycle. Indeed, some studies suggest that sleep duration is generally estimated to be countercyclical, with sleep duration decreasing when economic activity picks up. Most studies report a negative association between sleep duration and income. This may suggest that the investment in health and alertness can seem too expensive during economically prosperous times.

Intra-week and intra-day variation

Sleep differs between weekdays and weekends, when unstructured time allows for fewer restrictions on people's ability to satisfy their sleep needs. A recent study using the daily variation in sleep from Dutch sleep diaries also documents a higher variability of sleep on weekends and among younger and less educated people [1]. Sleeping on weekends

can become a form of recovery from tighter time schedules during the week. Similarly, day naps can be used to compensate for limited sleep at night. This is consistent with the above-mentioned increased dispersion in sleep time over the last several decades in the US.

Presence of young children

Sleep deprivation (sleep time) can increase (decrease) with the presence of children in the household and generally with parental duties that require dealing with the needs of children during nighttime. Using British cohort survey data, a study finds that an additional episode of a child waking up at night reduces the mother's sleep by almost ten minutes per night [6]. Although increasing the probability of both maternal and paternal sleep disruptions, the effect on maternal sleep is more than twice that on paternal sleep.

Light, time zones, temperature, and rainfall

Changes in light exposure, noise, or alternatively information and communication technologies, such as access to the internet or TV programs, can alter sleep time. Examining the timing of natural light at time-zone boundaries in the US, a study documents that an extra hour of natural light in the evening reduces sleep duration by an average of 19 minutes and increases the likelihood of reporting insufficient sleep [7]. This might arise because changes in exposure to natural light affect melatonin production, which affects sleep time. Light intensity in people's homes can exert an environmental influence on sleep quality as natural melatonin is influenced by exposure to light.

Another potential disruption of both the time and the quality of an individual's sleep is the proliferation of entertainment and communication technologies. Allocating time to such technologies might compete with the time that individuals would otherwise spend sleeping. That is, such technologies can become potential "sleep disrupters." Entertainment technologies, which some refer to as "digital temptations," can influence sleep not just by reducing sleep time but also because of the exposure to blue light technologies before bedtime. Differences in the timing of prime time TV in the US, which takes place an hour later in some US census regions, can affect bedtime [8]. Individuals in the early television zones are 3.4 percentage points less likely to be asleep at 7:00 a.m. and 3.4 percentage points more likely to be at work at 8:00 a.m. Consistent with this evidence, high-speed internet (DSL) technology affects sleep duration, as evidence from longitudinal German data shows [9]. Those individuals who have access to DSL tend to sleep 25 minutes less per night than their counterparts and are less likely to sleep the recommended number of hours.

Genetics or individuals' specific effects

It is important to recognize that some people simply need less sleep than others for genetic reasons. Hence, individuals who are genetically on the low end of sleep needs might face a lower opportunity cost of a sleep disruption, which provides them with an advantage in the short term. Genetics can also influence an individual's predisposition for sleep disorders.

Consequences of sleep deprivation

Sleep deprivation affects individuals' allocation of time to other activities and can influence the quality of duties involving brain functioning. Sleep affects how attentive people are in the workplace, and hence their focus and the probability of making mistakes on the job. Sleep deprivation is a problem of such a magnitude that when a population sample of individuals are asked what they would do with some extra time (a time windfall), devoting additional time to sleep is often the most common observed response [3]. However, sleep is not just the result of a time-accounting decision, as sleep quality is not fully under individuals' control, and is subject to encounters and emotions experienced daily in a person's professional and personal life. Commuting time, financial concerns, work stress, sugary diets, and mental health can all influence sleep [10].

Effects on the economy

Some research has been devoted to quantifying the effects of sleep on the economy. Using survey methods in different countries, one study estimates a large effect of sleep deprivation on the US economy [10]. The monetary costs to the economy due to insufficient sleep are estimated at 1.9% to 2.9% of GDP in the US, 1.4% to 1.8% in the UK, 1.0% to 1.6% in Germany, and 0.8% to 1.6% in Canada.

Effects on health and leisure

Sleep deprivation predicts unhealthy behaviors related to a modern 24/7 society, such as psychosocial stress, an unbalanced diet, a lack of physical activity, and excessive electronic media use, among others. It is also associated with a range of negative health and social outcomes, including success at school and in the labor market. The SAS suggests that most people feeling sleepy experience irritability, headaches, and general unwellness, all of which affect their willingness to go out in the evening, thus impacting their leisure time [2].

Sleep deprivation is responsible for the desynchronization of circadian rhythms and thus might impair autonomic functions and have negative effects on individuals' health outcomes. The SAS finds worse self-reported health and feelings of stress among people feeling sleepy [2]. More specifically, when people are asked how sleepy they are on a 1 to 7 scale (7 being most sleepy), non-stressed individuals report an average of 2.1; the number rises to 3.9 among people with moderate stress, and 4.6 among those with severe stress.

Sleep, productivity, and earnings

Sleeplessness and poor-quality sleep can hamper an individual's cognitive performance and workplace productivity, including leading to traffic and industrial accidents, medical errors, and loss of work. The SAS shows that feeling sleepy interferes with people's focus (as reported by 48% of people feeling sleepy), and with their ability to get things done (as reported by 46% of people feeling sleepy) [2]. Workers who sleep fewer than six hours per day report on average about a 2.4 percentage point higher productivity loss due to absenteeism or presenteeism (i.e. unnecessarily long on-site working hours) than workers sleeping between seven and nine hours per day [10]. However, sleep not only produces an effect via utility and choice, but it also influences productivity directly or indirectly by affecting work motivation.

A US time-diary study uses within-time-zone variation in sunset times to identify the effect of sleep time on earnings, distinguishing between short- and long-term effects [4]. It finds that a one-hour increase in weekly sleep time generates a 1.1% increase in earnings in the short term, and a 5% increase in the long term. These results suggest increases in earnings resulting from even an extra hour each night exceed those produced by an extra year of formal education. Using a cohort study from the UK to examine the effects of variations in child sleep interruptions on a mother's sleep duration, a 2020 study estimates the effect of sleep on mothers' economic performance [6]. The study finds that increasing a mother's average nightly sleep duration by 30 minutes increases her participation in the labor market by 2.5 percentage points, her working hours by 7%, her household income by 4.9%, but her job satisfaction only very slightly, by 0.01 standard deviations. These effects are driven by one mechanism, namely the influence of maternal sleep on selection into full- versus part-time work. Increased flexibility of job schedules among mothers with longer job tenure does, however, mitigate the negative effects of sleep deprivation.

Some recent evidence from randomized control trials in India includes a randomized intervention that varied the provision of information, encouragement, and improvements to home sleep environments to examine how sleep is affected by the quality of (noise in) an environment. It shows that, although the effects on night sleep do not exert any significant impacts on productivity, changes in afternoon naps produce significant effects on cognition, productivity, decision-making, and labor supply [11].

One potential explanation of the effect of sleep on productivity is via effects on absenteeism. Some evidence suggests that workers who sleep fewer than six hours per day report on average about a 2.4 percentage point higher productivity loss (loss of six working days out of an average of 250 a year due to absenteeism or presenteeism) compared to workers sleeping between seven and nine hours per day [10].

Sleep effects on trust and pro-social behaviors

Sleep can affect people's trust and other pro-social behaviors. In a laboratory setting using online surveys of 184 young-adult participants, a study randomly assigned a task at different times of the day to capture the effect of the "circadian mismatch" among morning and evening types [12]. It found that sleep restriction reduces subjects' prosocial behaviors in general (including trust, trustworthiness, and altruistic giving). For instance, in dictator and trust games (these are common tools to elicit social preferences, where individuals are asked how much of an income or resource windfall they will share with others) sleep-restricted individuals offer about 20% less to other players.

The role of cognitive biases

One potential criticism of traditional economic approaches to sleep is that in understanding the choice of sleep, it is unclear how conscious individuals are in making their sleep decisions. The question is whether cultural or social reference points play a role in addition to careful cost–benefit calculations. Present-biased individuals might live more "in the moment." Hence, giving in to the temptation to delay bedtime might explain delayed bedtime choices [13]. This is because delaying bedtime sleep exerts immediate and visible effects in terms of extra productivity. Such effects are immediately salient, but the costs are delayed to the next day. The consequences of reduced sleep are less salient

and go unaccounted for in sleep decisions when individuals are motivated by other time allocation tasks.

LIMITATIONS AND GAPS

What researchers know about the economic effect of sleep is driven by evidence that contains possible errors in how sleep time, and especially sleep quality, is measured. Time diaries increase the precision of sleep measures, but they are affected by the specific time of the interview and are typically not collected longitudinally, for example, for the same individual over time. In contrast, generic questions about sleep (e.g. how well or how many hours does a person normally sleep) are less precise, yet offer significant variation over time on sleep quantity and quality and can be easily collected in survey data.

Typically, evidence for sleep research comes from the laboratory rather than from field experiments. As such, little is known about the importance of potential effects of the duration of different stages of NREM (non-rapid eye movement) and REM (rapid eye movement) sleep on economic activities. Many of these activities are endogenously formed with other economic decisions. The exception evidence comes mainly from a low-income setting in India and is unlikely to be relevant elsewhere [11]. Hence, it is important to complement such research with evidence on the effects of sleep in higher-income countries.

SUMMARY AND POLICY ADVICE

Sleep time exerts an important effect on people's stress and sense of restlessness, which influences employment and productivity. The magnitude of the direct impact of sleep deprivation on the economy is not insubstantial, and there might be additional general equilibrium effects from potential spillover on ill-health and leisure activities.

Although sleep time is to a large extent an individual choice, sleep quality is not always fully under the control of individuals, as it depends on environmental and other constraints. Furthermore, individuals suffer from cognitive biases that are influenced by the less salient consequences of reduced sleep compared to alternative allocations of time. That is, sleep time choices are severely influenced by a series of cognitive biases, such as present bias, which can influence bedtime. Evidence that small monetary incentives can influence sleep time suggests that even small financial incentives could act as a commitment device to help individuals overcome their present-biasedness, rather than a compensation for individuals' opportunity costs of alternative time allocations.

A potential intervention to increase the likelihood of individuals allocating more time to sleep is via the regulation of work schedules so that jobs encourage some flexibility in time use. This could overcome the influence of potential time constraints facing parents of new-born and young children that influence their sleep time. Other interventions include digital devices (e.g. sleep trackers), alongside pharmaceutical treatments such as melatonin supplements. Given the role of cognitive biases in influencing bedtime schedules, nudges such as smart phone reminders can play a role in prompting individuals about bedtimes and could hence overcome the inertial behavior arising from other, competing routines.

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Competing interests

The IZA World of Labor project is committed to the IZA Code of Conduct. The author declares to have observed the principles outlined in the code.

REFERENCES

Further reading

Antillón, M., D. S. Lauderdale, and J. Mullahy. "Sleep behavior and unemployment conditions." *Economics & Human Biology* 14 (2014): 22–32.

Ásgeirsdóttir, T. L., and S. P. Ólafsson. "An empirical analysis of the demand for sleep: Evidence from the American Time Use Survey." *Economics & Human Biology* 19 (2015): 265–274.

Key references

[1] Hamermesh, D. S., and G. A. Pfann. *The Variability and Volatility of Sleep: An Archetypal Approach*. IZA Discussion Paper No. 15001, 2022.

[2] Sleep in America Poll. *Americans Feel Sleepy 3 Days a Week, With Impacts on Activities, Mood & Acuity*. Washington, DC: National Sleep Foundation, 2020.

[3] Biddle, J. E., and D. S. Hamermesh. "Sleep and the allocation of time." *Journal of Political Economy* 98:5 (1990): 922–943.

[4] Gibson, M., and J. Shrader. "Time use and labor productivity: The returns to sleep." *Review of Economics and Statistics* 100:5 (2018): 783–798

[5] Handel, B., and J. Kolstad. "Wearable technologies and health behaviours: New data and new methods to understand population health." *American Economic Review* 107:5 (2017): 481–485.

[6] Costa-Font, J., and S. Fleche. "Child sleep and mother labour market outcomes." *Journal of Health Economics* 69 (2020).

[7] Giuntella, O., and F. Mazzonna. "Sunset time and the economic effects of social jetlag: Evidence from US time zone borders." *Journal of Health Economics* 65 (2019): 210–226.

[8] Hamermesh, D. S., C. K. Myers, and M. L. Pocock. "Cues for timing and coordination: Latitude, letterman, and longitude." *Journal of Labor Economics* 26:2 (2008): 223–246.

[9] Billari, F. C., O. Giuntella, and L. Stella. "Broadband internet, digital temptations, and sleep." *Journal of Economic Behavior & Organization* 153 (2018): 58–76.

[10] Hafner, M., M. Stepanek, J. Taylor, W. M. Troxel, and C. Van Stolk. "Why sleep matters—the economic costs of insufficient sleep: A cross-country comparative analysis." *Rand Health Quarterly* 6:4 (2017).

[11] Bessone, P., G. Rao, F. Schilbach, H. Schofield, and M. Toma. (2021). "The economic consequences of increasing sleep among the urban poor." *The Quarterly Journal of Economics* 136:3 (2021): 1887–1941.

[12] Dickinson, D. L., and T. McElroy. "Sleep restriction and circadian effects on social decisions." *European Economic Review* 97 (2017): 57–71.

[13] Avery, M., O. Giuntella, and P. Jiao. *Why Don't We Sleep Enough? A Field Experiment Among College Students*. IZA Discussion Paper No. 12772, 2019.

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