



Revisiting the relationship between wages and sleep duration: The role of insomnia



Golnaz Sedigh, Rose Anne Devlin*, Gilles Grenier, Catherine Deri Armstrong

Department of Economics, University of Ottawa, 120 University Private, Ottawa, Ontario, K1N 6N5, Canada

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ABSTRACT

This paper uses the 2005 and 2010 Canadian General Social Surveys (Time Use) to investigate the effect of wages on the sleep duration of individuals in the labour force. The endogeneity of wages is taken into account with an instrumental variables approach; we find that the wage rate affects sleeping time in general, corroborating Biddle and Hamermesh's (1990) main conclusion. A ten percent increase in the wage rate leads to an 11–12 min decrease in sleep per week. But this number masks several effects. The responsiveness of sleep time to wage rate changes depends upon the sex of the individual, whether or not sleep problems are present and general economic conditions. By far the largest adjustment is found for insomniacs in 2010, a year of general economic downturn in Canada. We also investigate the non-randomness of insomnia in the population by using a Heckman procedure, and find that the sleep time of female non-insomniacs is even more responsive to wage rate changes once account is taken of this selection bias, but otherwise selection was not a problem in our samples.

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1. Introduction

Individuals vary in the amount of time that they devote to sleep. Some average as little as four hours per night while others sleep more than ten hours. While part of this variation is biological, some of this variation has been shown to be related to choices influenced by economic incentives. If someone's promotion, for example, is contingent on getting a report done in a timely fashion, then sleep may be sacrificed. To earn more money in situations where the opportunity presents itself, work may take the place of leisure or sleep.

In a seminal article, Biddle and Hamermesh (1990, hereafter, BH) investigate empirically the extent to which individuals adjust sleep duration in response to economic stimuli. They demonstrate that socio-economic factors influencing the quantity of time an individual spends working, namely wage rate, non-labour income and level of educational attainment, also affect the quantity of time the individual spends sleeping. This result highlights the importance of recognizing the implied joint decisions determining an individual's work, leisure and sleep.

The literature examining how labour supply responds to wage rates ("labour-supply elasticities") and how this response affects a wide-variety of policy questions is massive. The policy implications of labour supply elasticities are of as much importance today as they have been in the past.¹ Several recent papers focus on labour-supply responses to policies affecting workers income, estimating for example how labour supply is influenced by income taxes (e.g., Ericson et al., 2015), or tax redistribution (Pestieau and Racionero, 2015) even whether education should be subsidized (Li and Zhang, 2015). Adjusting one's hours of sleep at the margin in response to wage changes, is another factor that may influence labour-supply elasticities and consequently affect policy prescriptions and their effectiveness.

However, while in theory sleep duration may be a choice variable, in practice it is not always. Individuals who struggle getting to sleep or staying asleep may not be able to adjust sleep duration in response to economic incentives; others, who are just satisfying their sleeping needs, may be similarly insensitive. This paper examines whether economic incentives, namely wages, affect the sleep decisions of individuals taking account of sleep disorders ("insomnia"), helping to improve our understanding of how the labour supply responds to wages.

* Corresponding author.

E-mail addresses: golnaz80@gmail.com (G. Sedigh), radevlin@uottawa.ca (R.A. Devlin), Gilles.grenier@uottawa.ca (G. Grenier), Cdermstrong@uottawa.ca (C. Deri Armstrong).

¹ For example, a simple search of "labour-supply elasticities" on March 22, 2016 yielded 1362 publications from 1966 to 2016 in the search engine ECONLIT.

Between a quarter and a third of people in developed countries suffer from some sort of sleep problems (Sutton et al., 2001; Doi et al., 2003; Morin et al., 2006; Stewart et al., 2006). The social importance of sleep disorders is far reaching, having been shown, for instance, to decrease productivity and increase absenteeism, to increase the frequency of accidents, alcohol consumption and depression (Daley et al., 2009) leading to large economic costs (Daley et al., 2009; Walsh and Engelhardt, 1999); chronic sleep problems are also linked to several, costly, health conditions (see discussion in Antillon et al., 2014).

In this paper, we use the 2005 and 2010 Canadian General Social Surveys to contribute to the small literature that examines the relationship between sleep duration and wages, and to examine whether sleep problems affect the previously documented relationship. We find that the presence of sleep disorders does matter when it comes to responding to changes in wages, but that their influence differs across sexes and the state of the economy in general. In 2005, for instance, when the Canadian economy was in a period of growth, individuals with insomnia did not adjust their sleep time to changes in wages, but this was not the case in 2010. In 2010, when the economy was still suffering from one of the worst recessions of recent decades (Cross and Bergevin, 2012),² males with sleep problems adjusted their sleep time in response to wages whereas others did not. Our findings suggest that taking account of sleep problems, sex, and economic conditions is important when estimating labour supply responses to wages.

2. The determinants of sleep

2.1. Non-Economic determinants: insomnia

Insomnia, defined as having “difficulty initiating and/or maintaining sleep or a non-restorative sleep for at least one month”³; is a pervasive condition. Treating insomnia is considered difficult for several reasons: for instance, it is often thought of as being “. . . benign, trivial, or something one should be able to cope with alone. . .” (Stinson et al., 2006, p. 1643). General practitioners and pharmacists may lack sufficient information about sleep problems to effectively assist in its treatment. Vincent and Lionberg (2001) find that most practitioners choose pharmacological treatments (like sleeping pills), while patients fearing side-effects prefer psychological ones (like counselling for anxieties). Although various treatments exist, in a review of some 37 studies on insomnia, Morin et al. (2006) conclude that neither psychological nor behavioural therapies nor pharmacological treatments can cure insomnia completely.

Insomnia has been shown to be correlated with age, gender, marital status, education, income, work time, and unemployment (Ohayon and Zulley, 2001; Paine et al., 2004; Tjepkema, 2005; Xiang et al., 2008; Virtanen et al., 2009; Gu et al., 2010). Individuals with insomnia sleep less than those who do not suffer from the condition (Hurst, 2008; Brochu et al., 2012): Brochu et al. (2012) estimate that men and women who have sleep problems sleep on average 1.4 and 2.4 fewer hours in a week than those who do not.

² The severe recession of 2008–2009 came after 16 years of “uninterrupted expansion” (Cross and Bergevin, 2012, p.1).

³ This definition of insomnia is from the Diagnostic and Statistical Manual of Mental Disorders (DSM) [<http://web4health.info/en/answers/sleep-insomnia-what.htm>], the standard classification of mental disorders used in Canada (developed in the United States) [<http://www.psych.org/mainmenu/research/dsmiv.aspx>].

2.2. Economic determinants

Becker (1965) presents sleep as one of the main activities to which people allocate their time in order to maximize utility. Modelling the wage rate as the (opportunity) cost of non-market time, including sleep, he observes that sleep is “required for efficiency” (Becker, 1965 p.498). Economic models usually take hours of sleep as given, and have individuals choose only between labour and leisure from the remaining time. Biddle and Hamermesh (BH) (1990) were the first to develop a model in which individuals explicitly choose their number of hours of sleep; they predict that, all else equal, higher wages should be associated with less time devoted to sleep. This prediction is tested and confirmed empirically using the 1975–76 General Social Survey data from the United States. The key implication of this result is that ignoring sleep in models of labour supply may lead to incorrect estimates of the effect of wages on hours worked (the labour supply elasticity).

Other papers have examined the relationship between a variety of economic variables and sleep. One paper closely related to BH is Szalontai (2006) who uses South African time-use data from 2001 to confirm the negative relationship between wages and sleep duration. Hurst (2008) employs Statistics Canada’s General Social Survey (GSS 2005) data to provide a descriptive summary of the relationship between income and sleep, and finds that higher income individuals sleep less than those with lower incomes. Brochu et al. (2012) pool three cycles of the Canadian GSS (1992, 1998, and 2005) to examine whether economic conditions, as measured by the unemployment rate, affect sleep. Their results suggest that as economic conditions worsen (higher unemployment rates), and the opportunity cost of time falls, individuals respond by sleeping more. Antillon et al. (2014) corroborate these findings using US time-use data. In a related set of papers, Ásgeirsdóttir and Zoega (2011), Ásgeirsdóttir et al. (2014) and Ásgeirsdóttir and Ólafsson (2015) find that the lower wages associated with economic downturns in Iceland led to increased sleep duration. In contrast, Nena et al. (2014) find that sleep duration fell during the Greek financial crisis, suggesting that the positive impact of a lower cost of sleep was overwhelmed by the stress associated with the crisis.

3. Methods and data

3.1. Methods

The main model estimated by BH and upon which this work is based is:

$$S^i = \beta_0 + \beta_1 \ln W^i + \beta_2 H^i + \beta_3 X^i + \beta_4 \ln M^i + \varepsilon^i \quad (1)$$

where S^i is sleep duration measured in minutes per week by individual i ; $\ln W^i$ is the logarithm of the wage rate per hour; H^i denotes a dummy variable representing the health of the individual; X^i is a vector of the following personal characteristics: such as age, marital status, gender, presence of children less than five years old, and religion; and $\ln M^i$ is the logarithm of other income or non-labour income of individual i ; ε^i is the error term. Our estimated model can be considered as a “modified BH model” as we make a few additions/changes based on the differences in the nature of the available data as explained further below. All summary statistics and regressions are weighted using Statistics Canada’s personal weights.

Eq. (1) aims to capture the impact of the wage rate and other income on sleep duration. However, the factors that influence the amount of sleep undertaken by an individual may also affect the wage rate that the individual commands. Motivating the seminal

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