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Revisiting the Relationship between Economic Factors and Sleep Duration: The Role of Insomnia[*]

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Abstract

This paper uses the 2005 Canadian General Social Survey (GSS) to investigate the effect of economic factors on the sleep duration of individuals in the labour force. It extends previous work by Biddle and Hamermesh (1990) by looking at the role played by insomnia, a condition affecting somewhere between a quarter and a third of the general population, on the link between economic variables and sleep duration. While a 10 percent increase in the wage rate is found to decrease sleep duration by almost 20 minutes per week for non-insomniacs, no such relationship between wage and sleep duration is found for insomniacs. This finding suggests that insomniacs cannot, or do not, tradeoff sleep for possible economic returns.

Key words: *sleep duration, wage, insomnia.*

JEL Classification: J22, I12.

Résumé

Une reconsidération de la relation entre les facteurs économiques et la durée du sommeil : le rôle de l'insomnie. Cet article utilise l'Enquête sociale générale canadienne (ESG) de 2005 pour étudier l'effet des facteurs économiques sur la durée du sommeil des individus dans la population active. Il étend les travaux antérieurs de Biddle et Hamermesh (1990) en considérant le rôle joué par les troubles du sommeil, une affection qui touche quelque part entre un quart et un tiers de la population, sur le lien entre les variables économiques et de la durée du sommeil. Alors qu'une augmentation de 10 pour cent du taux de salaire diminue la durée de sommeil de près de 20 minutes par semaine pour les non-insomniaques, il n'existe aucune relation entre le salaire et la durée du sommeil pour les insomniaques. Cette constatation suggère que les insomniaques ne peuvent pas, ou ne veulent pas, sacrifier leur temps de sommeil en échange d'avantages économiques.

Mots clés : *durée du sommeil, salaire, insomnie.*

Classification JEL : J22, I12.

Revisiting the Relationship between Economic Factors and Sleep Duration: The Role of Insomnia

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 it 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 that influence 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 decision determining an individual's work, leisure and sleep.

BH's model and empirical strategy assume that individuals have the ability to choose the amount of time they devote to sleep. However, while sleep duration may be under the control of most people, this may not be the case for everyone; those who struggle getting to sleep or staying asleep may not be able to adjust sleep duration in response to economic incentives. This paper is the first to examine whether economic incentives affect the sleep decisions of individuals with sleep disorders ("insomnia").

Insomnia, defined as having "difficulty initiating and/or maintaining sleep or a non-restorative sleep for at least one month"[1] is a strikingly pervasive condition. Overall, it is estimated that between a quarter and a third of people in developed countries suffer from insomnia (Sutton et al., 2001; Morin et al., 2006; Stewart et al., 2006; Doi et al., 2003). The social importance of this condition is far reaching, having been shown, for instance, to decrease productivity and increase absenteeism. Further, insomnia has been related to frequency of accidents, alcohol consumption and depression (Daley et al., 2009), engendering large economic costs (Daley et al., 2009; Walsh and Engelhardt, 1999).

In this paper, we use the 2005 Canadian General Social Survey to contribute to the small literature that examines the relationship between sleep duration and economic incentives and to examine whether insomnia distorts the previously documented relationship. Our main finding is that insomnia does indeed play a role. While the previously established negative relationship between sleep and wages is found for non-insomniacs – a 10% increase in the wage rate decreases sleep duration for non-insomniacs by 20 minutes per week – no such relationship is found for insomniacs. Insomniacs cannot, or do not, tradeoff sleep for possible economic returns.

2. The Determinants of Sleep

2.1 Non-Economic Determinants: Insomnia

Insomnia is a health problem that affects a lot of people. Treating insomnia is considered difficult for several reasons. For instance, insomnia is often thought of as being "…benign, trivial, or something one should be able to cope with alone…" (Stinson et al., 2006, p. 1643).

[1]This is the definition of insomnia provided in Diagnostic and Statistical Manual of Mental Disorders (DSM) [http://web4health.info/en/answers/sleep-insomnia-what.htm]. "The *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*) is the standard classification of mental disorders used by mental health professionals in the United States." [http://www.psych.org/mainmenu/research/dsmiv.aspx].

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 survey 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.

2.2 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). Biddle and Hamermesh (BH) (1990) develop a model in which individuals explicitly choose their number of hours of sleep. The model predicts 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 Study data from the US. 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.

Since BH, other papers have examined the relationship between a variety of economic variables and sleep. The paper most 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. The results suggest that as economic conditions worsen (higher unemployment rates), and the opportunity cost of time falls, individuals respond by sleeping more. In a related set of papers, Ásgeirsdóttir and Zoega (2011) and Ásgeirsdóttir et al. (2014) 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:

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

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 socio-economic factors 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. Equation (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. Highly motivated people, for instance, may have higher wages and lower sleep requirements. A simple OLS regression would falsely attribute lower sleep duration to the higher wages when both sleep and wages were simultaneously determined by the unobserved 'motivation' characteristic of the individual. To address this potential endogeneity, an instrumental variables procedure is applied wherein "instruments" – variables that are correlated with wages but uncorrelated with the error in the sleep equation – allow for the identification of causal links between the wage rate and sleep duration.

Following BH, union status, occupation, education, industry codes, regions (provinces), and a dummy variable for metropolitan areas are all potential instruments to deal with the endogeneity (as elaborated on below). Finally, to test whether insomnia affects the impact of socio-economic variables on sleep duration, equation (1) is re-estimated separately for those with and without insomnia.

3.2 Data

This study uses the Canadian General Social Survey (GSS) - Time Use 2005, which asks respondents to complete a diary listing all their activities over a 24-hour designated day beginning at 4:00 am. BH's main dependent variable is time spent sleeping and napping (resting) per week, using the US time use survey data 1975-1976. The benefit of using time use data is that individuals report their sleep duration in minutes, generating more variation in the data on sleep duration than is available in surveys that simply ask about usual hours of sleep. Lauderdale et al. (2008) and Robinson and Michelson (2010) report that surveys that ask about a single night of sleep duration are better for analyzing sleep than are surveys with self-reported usual hours of sleep. According to Lauderdale et al. (2008), the correlation between wrist-monitored sleep

duration with self-reported usual sleep duration is 0.45; whereas, the correlation between wrist-monitored sleep duration with single night reported sleep duration is 0.60. This result suggests that single night sleep duration reflects better the real sleep time than self-reported usual sleep time.

Our sleep variable is created based on the number of minutes the individual reports sleeping over the 24 hours in question, including naps. In order to ensure that the given day is representative, we remove all observations taken of individuals during the weekend. As BH's dependent variable is time spent sleeping and napping (resting) per week, we multiply the daily sleep duration by seven to get the weekly time spent sleeping.

Like BH, we include measures of work time, marital status, age, education, gender, health status, presence of young children, religion, wage, and other income. Some differences exist between the US and Canadian datasets. We do not have "years married" and could only include "marital status"; we do not have a variable for "race" but include richer information on religion (BH have one dummy variable for Protestant, we include four dummy variables: one for Roman Catholics, one for United Church and Protestant, one for other religions, and one for people without a religion (the reference category)); years of schooling is not available in the Canadian GSS, but four dummy variables are used for education levels denoting some secondary or less, a high school diploma (the reference category), a diploma/certificate from community college or some university/community college and a doctorate/masters/bachelor's degree. The variable for the presence of children under three years old could not be created; instead a binary variable for the presence of children less than five years old is used.

The variable of interest, wage, is created from the annual personal income divided by 12 months, divided again by 4.3 (weeks in a month) and then divided by the number of hours

usually worked at all jobs in a week to get the hourly wage. BH used monthly earnings instead of annual personal income; earnings are but one component of personal income which also includes income from investments, retirement income, and the like. BH created the variable "other income" by subtracting individual earnings and his/her spouse's earnings from total household income. Since we do not have spousal earnings, the "other income" variable is created by subtracting personal income from total household income and hence includes spousal income. Moreover, the GSS 2005 provides household income in 12 ranges; we estimate annual household income as the mid-point of each range, except for the last one (income higher than $100,000) where we follow others and use $150,000 ($100,000 times 1.5) (Phipps et al., 2001; Brochu et al., 2012). Because our income measure is different than that of BH, care has to be taken when comparing our results with theirs.

In addition to estimating equation (1) for everyone in our sample, we divide the sample into two groups: those reporting regular sleep problems (insomniacs) and those who do not (non-insomniacs). The grouping is based on the answer to the following question in the GSS 2005: "Do you regularly have trouble going to sleep or staying sleep?" We construct a binary variable which is zero for those who do not report having sleep problems and one for those who do.

We start with 19,597 observations in the GSS 2005, and impose a number of restrictions: like BH, we include only respondents of working age (23 to 65 years); because sleeping patterns may differ across weekdays and weekends, we restrict the sample to those who reported their activities on a weekday; students are also removed; since the sample is limited to workers, those with zero or missing 'number of hours usually worked' at all jobs are dropped. We are left with an initial usable sample of 6,915 observations (2,086 insomniacs, 4,824 non-insomniacs, and 5 individuals whose insomnia status was indeterminate).

Table 1 reports the mean values of some selected variables weighted by the sample weights provided by Statistics Canada, for the full sample and for insomniacs and non-insomniacs grouped by sex. On average, people slept 7 hours and 48 minutes per night (3,278 minutes per week). The average age in the sample is 42 years, average time at work per week is 42 hours, and men work 8 hours per week more than women on average. Almost 6% of the individuals have at least one child under the age of five. Twenty-nine percent of the sample suffers from insomnia, and only 11 percent report their health condition as poor or fair. In general, insomniacs are less healthy than non-insomniacs.

(Table 1 about here)

4. Empirical Results

Equation (1) is estimated using an instrumental variables procedure treating the wage rate as endogenous. Following BH, education, union status, large CMA (metropolitan area), regions (provinces), and industry dummy variables (NAICS[2] codes) are employed as instruments for the wage rate. Since the information on some variables of interest is missing (mainly the wage and the NAICS codes), the sample for this analysis is smaller than the original one. The first column of results in table 2 reports the estimated coefficients from the same specification as BH. An increase in the wage rate is found to have a negative and significant impact on sleep duration: on average, a ten percent increase in the hourly wage rate decreases sleep duration by 19.1 minutes in a week. This result is consistent with BH in spite of differences in the calculation of the wage variable: they find that a ten percent increase in hourly wages decreases the sleep duration by 14.1 minutes a week.

[2] The North American Industry Classification System (NAICS) is a standard way of classifying business establishments.

(Table 2 about here)

The quality of the instruments must be assessed. A good instrument is correlated with the wage rate and uncorrelated with the error term of the sleep model. First stage robust F-statistics for the joint significance of the coefficients on additional instruments are reported at the end of table 2, and are significant at the one percent level irrespective of specification employed, satisfying the first condition that they are correlated with the wage rate. The second condition that the instruments must be uncorrelated with the error term cannot be tested directly, but we ran regressions that included the instruments into the sleep equation and found that the location variables, the CMAs and provincial dummy indicators, had a direct impact on sleep time. We thus ran the model explicitly including these two variables. The results of the following four columns of table 2 report the estimated coefficients from the model with only union status, education and industry (NAICS) dummy variables as instruments for the wage rate.[3]

The results reported in table 2 arising from the modified set of instruments and regressors are very similar to those reported in the previous column: a 10 percent increase in the wage rate decreases sleep duration by 17. 6 minutes per week. We also ran this model by sex and found the impact of a ten percent increase in the wage rate to be 20.8 minutes per week for men and 15.6 minutes per week for women, compared to 18.2 minutes for men and 6.4 minutes for women in BH.

In sum, our results confirm that which was originally reported by BH, namely that sleep time responds to the wage rate. The question now becomes what happens if we separate the sample into those who have sleep problems (insomniacs) and those who do not (non-

[3] When there are more instruments than endogenous variables as is the case here, an overidentifcation test can be conducted for the correlation of the additional instruments with the error term, assuming in turn that that each particular instrument is not correlated with the error term. The exclusion restriction that the instruments are uncorrelated with the error term held for all but the regressions where men and women non-insomniacs were treated together.

insomniacs). Table 2 reports the regression results from the modified BH model applied only to non-insomniacs, both all of them and when this sample is parsed by males and females. Across the board, the wage rate matters for the sleep time of non-insomniacs. A 10 percent increase in the wage rate significantly decreases sleep duration by 19.0 minutes per week (as compared to 17.6 when both insomniacs and non-insomniacs were included). Parsing the non-insomniac group by sex, the sleep of males continues to be more responsive to wage incentives than that of females: a 10 percent increase in the wage rate decreases the sleep of non-insomniac men by 20.3 minutes per week, as opposed to 16.3 minutes for non-insomniac women.

Even more interesting is the fact that the wage rate has no impact whatsoever for the insomniac group. Table 3 presents the estimated impact of wages on sleep time for the entire insomniac sample and for men and women separately. The wage rate has no statistical impact on sleep time for insomniacs, and the estimated coefficient on wage rate is always much lower than that found for the non-insomniac group. This finding means that the link between economic incentives and sleep time is broken when individuals experience sleep problems – a result consistent with the notion that individuals suffering from insomnia have less control over their sleep.

(Table 3 about here)

One issue that deserves attention is the possible non-randomness of insomnia in the population. If there are factors that affect both the wage rate and whether or not the individual is an insomniac, then the estimate of the effect of wages on sleep time would be compromised. We use a "Heckman" two-stage approach (Heckman, 1979) to address this non-randomness issue. This approach entails modelling the factors influencing the likelihood that an individual is an insomniac (stage one), constructing a test statistic (the Inverse Mill's Ratio) based on the

estimates from this model, and including this test statistic in the second stage model of the determinants of sleep duration. Insomnia is assumed to be a function of health, time spent working, wage, marital status, age, gender, educational attainment, health, having young children, religion, other income, shift work, and stress.[4] These last two factors are excluded from the second stage regressions and help to identify to which of the insomniac – non-insomniac groups the individual belongs.

Before turning to the second-stage results, table 4 presents the marginal effects from the first-stage selection model for the full sample and parsed by sex. We find that time at work has a small negative impact on the likelihood of reporting insomnia. The probability of having insomnia is five percentage points less for married/common-law individuals than for unmarried ones. Men are less likely to experience insomnia than women as are educated people when compared to the less educated, consistent with the findings of Xiang et al. (2008) and Tjepkema (2005). Being healthy decreases the probability of having insomnia by 16 percentage points, as reported elsewhere (Tjepkema, 2005; Xiang et al., 2008; and Gu et al., 2010). Women with young children have less insomnia, and any type of religion decreases the probability of insomnia. Non-regular shift work increases the probability of having insomnia by 26 percentage points and having stress in one's life can increase the probability of having insomnia by almost 50 percentage points (like Tjepkema, 2005).

(Table 4 about here)

The inverse Mill's ratio from the selection model is included as an explanatory variable in the sleep-duration model and is found to be statistically significant only in the specification for non-insomniac women – which means that it is only for this group that selection is a problem.

[4] The sample size for these analyses is different due to missing observations in the work time, education, stress and shift work variables.

Once we control for selection bias using the Heckman procedure for the female non-insomniac group (reported in final results column of table 2), the responsiveness of their sleep duration to wages mirrors that of men: a 10 percent increase in the wage rate decreases women's sleep duration by 20.73 minutes per week.

Finally, after having undertaken all of the analysis using the GSS 2005, another cycle of time use data, the GSS 2010, became available. We redid the analysis using the newer data and found two notable differences over the results just reported. First, when replicating BH's model, the response of men to a change in the wage rate was a bit smaller using the 2010 data (table 5): a 10 percent increase in wages would elicit 17 more minutes of work per day as opposed to almost 20 minutes using the 2005 data. This new estimate is also less precise, with statistical significance at the 10% level. Second, wages were not found to affect the sleep time of women. It was informative to undertake the analysis using a different year of data as our findings suggest that the impact of wage rate on sleep duration may not only a function of the characteristics of the individual, but may also of broader characteristics of the environment in which these decisions are made. 2005 and 1975-76, the year under study by BH, were periods of economic growth, whereas in 2010 was a period of retrenchment. One possibility raised by our findings is that people react less to an increase in the wage rate (the "opportunity cost" of time) during economic downturns (as was the case in 2010) compared to during growth periods.

(Table 5 about here)

5. Conclusions

Motivated by the seminal work of Biddle and Hamermesh (1990), we investigate the impact of economic factors on sleep duration. Like in BH's work, the endogeneity of sleep

duration is taken into account. Using a sample of workers aged 23-65 from the 2005 Canadian General Social Survey, we confirm that on average individuals react to increases in wage rates by sleeping less. This result is important as it implies that when economists examine the responsiveness of labour supply to changes in its price, they must account for the fact that some individuals also adjust their sleep.

The link between wages and sleep duration, however, does not exist for individuals with insomnia. Whereas a 10 percent increase in the wage rate decreases sleep duration by almost twenty minutes per week for non-insomniacs, there is no similar impact among insomniacs. Insomniacs either do not want to, or more probably, cannot trade-off sleep duration for economic returns. Irrespective of whether responding to fluctuations in wage rates by adjusting sleep duration is good or bad for the individual, employer or society, our results imply that individuals with insomnia do not respond to economic incentives in the same way as non-insomniacs.

Empirical work can always be improved with more and better data. For instance, our understanding of insomnia may be improved by including a variety of factors known to affect sleep, including depression levels, chronic diseases, the use of sleep medications and activity limitations. Unfortunately, this information is not available in time use surveys. Longitudinal data would allow one to examine more carefully the impact of the business cycle on work patterns, when accounting for sleep disorders.

In spite of its limitations, this study is the first to compare the impact of wage on sleep duration among insomniacs and non-insomniacs and reveals that insomnia breaks the link between wages and sleep duration. Sleep is important – those having trouble getting and staying asleep, lacking quality restorative sleep, can have huge, measurable implications on themselves (depression), work (absenteeism) and society (accidents, societal costs). While the

unresponsiveness of insomniacs to changes wage changes is unlikely to change a career path, it highlights one way in which this large group is different. Given the importance of sleep to cognitive functioning and decision making, future work might consider other aspects of labour market interactions of insomniacs.

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Table 1. Summary Statistics, Selected Variables

	All (n=6,915)	Insomniacs			Non-insomniacs		
		All (n=2,086)	Men (n=852)	Women (n=1,234)	All (n=4,824)	Men (n=2,506)	Women (n=2,318)
Sleep (minutes per week)	3,278 (757)	3,258 (783)	3,248 (751)	3,267 (809)	3,285 (743)	3,249 (773)	3,335 (696)
Age	41.79 (10.52)	41.60 (10.58)	41.15 (10.71)	41.97 (10.46)	41.86 (10.49)	42.20 (10.56)	41.37 (10.38)
Less than High School	0.09	0.09	0.09	0.09	0.08	0.10	0.06
Diploma or certificate from community college or some university or community college	0.45	0.50	0.49	0.51	0.43	0.42	0.45
Doctorate/masters/bachelor's degree	0.29	0.24	0.22	0.25	0.31	0.31	0.32
Work (minutes per week)	2,527 (834)	2,488 (895)	2,746 (835)	2,271 (887)	2,543 (807)	2,737 (807)	2,271 (723)
Children less than 5 at home	0.05	0.04	0.06	0.02	0.06	0.06	0.06
Excellent, very good, or good health	0.89	0.81	0.82	0.80	0.92	0.92	0.92

Notes: standard deviations are reported in parentheses. The numbers are weighted.

Table 2. Regression Results: Full and Non-Insomniac Sample						
Dependent variable (sleep minutes per week)	BH Model	Modified BH Model	All non insomniacs	Men non insomniacs	Women non insomniacs	Heckman: Women non insomniacs
Ln (wage)	-190.94*** (50.04)	-175.68*** (56.93)	-189.52*** (58.94)	-203.16** (81.87)	-163.18** (77.99)	-207.31*** (77.27)
Married/ common law	10.42 (34.81)	3.61 (34.61)	3.89 (41.53)	-28.44 (60.50)	37.68 (58.27)	18.63 (58.50)
Age	-11.37 (11.32)	-11.93 (11.19)	-7.42 (12.47)	-2.12 (17.21)	-16.55 (17.11)	-13.91 (16.94)
Age square	0.12 (0.13)	0.12 (0.13)	0.07 (0.14)	0.00 (0.20)	0.20 0.20	0.18 (0.20)
Male	-2.21 (28.49)	-4.47 (28.54)	-35.64 (31.48)	---	---	---
Excellent, very good, or good health	9.22 (41.51)	11.74 (42.06)	-32.08 (51.95)	-85.80 (72.89)	20.81 (64.87)	-119.87 (73.70)
Children less than 5	-115.45** (47.67)	-117.05** (47.55)	-124.74** (56.22)	-233.15*** (72.15)	59.95 (85.99)	-23.00 (86.45)
Roman Catholic (reference: no religion)	-44.59 (39.97)	-39.93 (42.13)	33.77 (44.51)	69.82 (58.95)	-28.82 (66.16)	-15.25 (65.50)
United Church and Protestant	-44.68 (40.74)	-28.53 (41.44)	16.66 (45.34)	65.27 (60.12)	-43.73 (66.72)	-21.52 (66.94)
Other religion	-16.14 (77.29)	-15.08 (77.80)	19.18 (96.41)	-21.34 (143.59)	64.06 (102.59)	74.60 (103.11)
Ln (other income)	10.33 (6.74)	11.90* (6.69)	6.25 (7.54)	-1.86 (9.27)	13.75 (12.26)	14.25 (12.18)
CMA	---	-53.13 (33.20)	-68.77* (39.66)	-64.32 (56.07)	-62.13 (51.00)	-71.71 (51.24)
Province fixed effect	---	Yes	Yes	Yes	Yes	Yes
Months of interview fixed effect	---	Yes	Yes	Yes	Yes	Yes
Inverse Mills Ratio (non insomniacs)	---	---	---	---	---	417.71*** (108.46)
Constant	4,059.80*** (255.22)	4,015.55*** (260.21)	3,996.26*** (253.71)	3,951.84*** (366.27)	4,062.69*** (336.76)	4,443.86*** (332.89)
Observations	4,596	4,596	3,149	1,583	1,566	1,566
First stage robust-F statistic	40.98***	37.26***	20.86***	13.81***	10.88***	10.40***

Notes: Robust errors are in the parentheses. The first column is estimated with IV using education, union status, industry dummy variables (NAICS codes), CMA and provinces as instruments. The remaining columns are estimated with IV using education, union status and industry dummy variables (NAICS codes) as instruments. The results are weighted. *** p-value<0.01, ** p-value<0.05, * p-value<0.1

Table 3. Regression Results: Insomniac Subsample			
Dependent variable	All insomniacs	Men insomniacs	Women insomniacs
Ln (wage)	-82.53 (113.02)	-137.48 (130.18)	-7.58 (178.36)
Observations	1,442	574	868
First stage robust-F statistic	17.09***	9.00***	12.62**

Notes: Robust errors are in the parentheses. The regressions are estimated with IV using education, union status and industry dummy variables (NAICS codes) as instruments. The results are weighted. *** p-value<0.01, ** p-value<0.05, * p-value<0.1

Table 4. First Stage Regression from Heckman Approach			
Dependent variable: Insomnia (a binary variable)	All	Men	Women
Work time	-0.00003*** (0.00001)	-0.00003** (0.00001)	-0.00004** (0.00002)
Ln (wage)	-0.01 (0.01)	0.02 (0.02)	-0.03* (0.02)
Married/common law	-0.05*** (0.02)	-0.06** (0.02)	-0.04 (0.03)
Age	-0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)
Age square	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Male	-0.09*** (0.02)	---	---
Some secondary/elementary/no Schooling (reference: high school degree)	-0.01 (0.03)	-0.03 (0.03)	0.09 (0.06)
Diploma or certificate from community college & Some university or community college	-0.00 (0.02)	-0.00 (0.03)	0.02 (0.04)
Doctorate/masters/bachelor's degree	-0.08*** (0.02)	-0.10*** (0.03)	-0.04 (0.04)
Excellent, very good, or good health	-0.16*** (0.03)	-0.14*** (0.04)	-0.18*** (0.04)
Children less than 5	-0.06* (0.03)	0.01 (0.04)	-0.15*** (0.04)
Roman Catholic	-0.04** (0.02)	-0.07*** (0.03)	0.01 (0.04)
United Church and Protestant	-0.04* (0.02)	-0.08*** (0.03)	0.03 (0.03)
Other religion	-0.06* (0.03)	-0.08** (0.04)	-0.01 (0.06)
Ln (other income)	0.00 (0.00)	-0.00 (0.00)	0.00 (0.01)
A regular evening shift Reference: a regular daytime schedule or shift	0.04 (0.05)	0.08 (0.07)	0.01 (0.06)
A regular night shift	0.14** (0.06)	0.13* (0.07)	0.15 (0.10)
A rotating shift	0.15*** (0.03)	0.20*** (0.04)	0.06 (0.04)
A split shift	-0.06 (0.07)	-0.10 (0.07)	-0.01 (0.11)
A compressed work week	-0.00 (0.09)	0.02 (0.11)	0.02 (0.14)
On call or casual	0.16**	0.26***	0.07

	(0.07)	(0.10)	(0.10)
An irregular schedule	0.11***	0.13***	0.09*
	(0.03)	(0.04)	(0.05)
Other type of shift	0.08	0.07	0.20
	(0.09)	(0.10)	(0.14)
Not very stressful			
Reference: not at all stressful	0.04	0.02	0.11
	(0.04)	(0.05)	(0.07)
A bit stressful	0.17***	0.15***	0.24***
	(0.04)	(0.04)	(0.06)
A quite a bit stressful	0.37***	0.35***	0.44***
	(0.04)	(0.05)	(0.06)
Extremely stressful	0.44***	0.40***	0.51***
	(0.05)	(0.08)	(0.06)
Province fixed effects	Yes	Yes	Yes
Month of interview fixed effects	Yes	Yes	Yes
Observations	5,524	2,744	2,780

Notes: Marginal effects are reported. Robust standard errors are in parentheses.
The results are weighted.*** p-value<0.01, ** p-value<0.05, * p-value<0.1

Table 5. Regression Results, GSS 2010			
Dependent variable: Sleep minutes per week	All BH Modified	Men BH Modified	Women BH Modified
Ln (wage)	-114.70* (64.40)	-170.09* (100.61)	-51.80 (82.28)
Married/common law	42.89 (46.67)	68.31 (68.90)	7.19 (61.56)
Age	-22.34* (13.06)	-8.91 (19.20)	-34.03* (17.62)
Age square	0.22 (0.15)	0.08 (0.21)	0.35* (0.20)
Male	-129.37*** (34.73)	---	---
Excellent, very good, or good health	-10.21 (49.70)	-37.13 (73.30)	8.27 (66.36)
Children less 5	-47.85 (49.58)	-123.01* (73.22)	43.34 (64.91)
Roman Catholic	3.03 (45.80)	15.34 (64.58)	-28.61 (65.37)
United Church and Protestant	-14.20 (45.75)	4.82 (68.64)	-46.37 (61.67)
Other religion	33.64 (69.84)	51.64 (98.78)	9.71 (94.48)
Ln (other income)	-0.79 (9.68)	-3.93 (14.08)	4.70 (11.87)
CMA	-21.89 (39.55)	3.85 (60.47)	-52.67 (48.96)
Province fixed effect	Yes	Yes	Yes
Months of interview fixed effect	Yes	Yes	Yes
Constant	4,240.03*** (311.71)	4,073.62*** (503.47)	4,256.39*** (376.59)
Observations	3,319	1,500	1,819
First stage robust- F statistic	19.05***	7.74***	14.28***

Notes: Robust errors are in the parentheses. Columns 1-3 are estimated with IV using education, union status and industry dummy variables (NAICS codes) as instruments. The results are weighted. *** p-value<0.01, ** p-value<0.05, * p-value<0.1