Sleeping Through the Great Recession

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Abstract

This analysis uses time use data as well as employment data to relate and model the effect of state level employment rate (EPR) to an individual's time spent sleeping. The conclusion is that rises in the EPR are correlated with a drop in time spent sleeping on the order of 1.85 minutes for every 1 percentage increase in the EPR. There is little to no variation among different age groups and sexes, with the exception being black women. These conclusions are in line with previous research which do find that health is countercyclical. This analysis adds to the literature by allowing the EPR's effect on health to vary across different groups.

Introduction

This analysis targets the question of how the economy affects how much an individual sleeps. While sleep isn't the most studied economic variable, it is the single largest activity that people spend time on and while it is a biological necessity, it has been shown to be subject to choice like many other economically important activities.

With this goal in mind, this paper uses current employment statistics from the Bureau of Labor Statistics (BLS) in conjunction with the American Time Use Survey (ATUS) to model this relationship between the economy and the amount people sleep. A fixed effects model estimates the effect of changes in the EPR for different subgroups. The results indeed align with research that shows sleep time to be countercyclical.

While the results do not show much difference across age group and most age or sex/race subgroups, they do show that black women's' sleep responds more to changes in economic conditions. This is indicative that black women are more sensitive to aggregate economic conditions relative to other groups.

Literature Review

Sleep is both a biological need, and a choice good. When given more time, people respond by sleeping more; when presented with demanding conditions, people may sleep less.

This has first been shown in Hamermesh & Biddle (1990). This is the seminal paper in sleep economics, the first one to not treat the time that people spend sleeping as a given. The goal of their paper was to develop the first theoretical model of the demand for sleep and actually empirically see how work hours, leisure hours, and sleep hours are related. They concluded that a one hour increase in time spend working results in a 13 minute decrease in sleep time and 47 minute decrease in non-market waking time. Sleep is therefore inversely related to time spent working. Additionally,

there is an effect of wage level on time spent sleeping. Higher wages are associated with lower amounts of leisure and time spent sleeping, and this was especially true for men.

A difficult part of modeling demand for sleep was sleep's effect on alertness. Sleep affects alertness which in turn affects labor market productivity and therefore wealth. So sleep has two ways in which it affects utility; by rejuvenating the individual which directly gives utility and by indirectly increasing productivity which affects wealth. This benefit to sleep comes at the cost of sacrificing time that could be used working for some wage or enjoying non-market leisure time.

This model developed by Hamermesh & Biddle has been the basis for other models such as that used in Asgeirsdottir et al. (2011). They look specifically at the 2008 recession in Iceland and how individuals' behavior changed as a result of huge changes to wealth and time due to the economic crash. They developed a model that factors in alertness and how that affects quality of leisure time as well as work time. Their model is consistent with their dataset and also reaches many of the conclusions that Hamermesh & Biddle reached, i.e. having children lowers sleep minutes.

The conclusion about children and sleep again is found again in Hamermesh (2002). Using Dutch time budget data on the windfall hour, Hamermesh finds significant results that given the extra hour, increases in time available increase time slept. The data used is a close approximation of exogenously giving Dutch people one more hour in a day and seeing what they do with it, with the caveat being that some may have prepared their day ahead of time knowing there would be an extra hour. While all subgroups did spend 27 minutes or more of the extra hour sleeping, those with children and those who were married especially slept more; women with children under the age of 13 on average spent 59.88 minutes of the hour sleeping.

Asgeirsdottir et al. (2013) again looks at the 2008 recession in Iceland, where different behaviors related to health, including sleep, were affected by the recession. Asgeirsdottir et al. found that people adopt less healthy behaviors and engage in risky behaviors when the economy is in growth. This includes eating more fast food, drinking more alcohol, smoking more, and even sleeping less. Healthy behaviors are found to be countercyclical; in part because price changes made unhealthy activities more expensive.

This finding that healthy activities may be countercyclical might be related to results found by Ruhm (2000, 2015). In these papers, Ruhm finds that the mortality rate is procyclical. For most causes of death, with suicide a noted exception, a better economy means higher rates. This is true for car accidents, heart-disease, obesity, and other causes of death. It can be imagined how the results found by Asgeirsdottir et al. are related to Ruhm's results; unhealthy lifestyles that rise during a growing economy could be facilitating this rise in deaths.

Colman & Dave (2013), much like Ruhm and Asgeirsdottir et al., use data to model the effect of the economy on different health outcomes. Colman & Dave's analysis focuses on explaining how peoples' actual daily activities are affected by the economy; how much more active or sedentary people become during a Recession. The idea is to use Metabolic Equivalent Time (MET) to convert values from individuals' diary days in the ATUS to a metric that directly measure health. They run regressions with the coefficient on state level monthly employment rate as the variable of interest.

Their analysis finds that people do become more sedentary during a Recession. The 2008 Recession predominantly affected those in more labor intensive jobs; while they may have exercised more after becoming unemployed, overall their lifestyles were more sedentary. Their analysis includes minutes spent sleeping as a dependent variable, and show that as the employment

rate rises, individuals sleep less, on the order of 1 to 2.2 minutes per percent in the employment rate depending on specifications in the model. Their results are largest for lower education females. Colman and Dave's results support the general consensus from Ruhm and Asgeirsdottir that many activities that we would find as health promoting such as time spent sleeping are counter cyclical. It is this general model, where the dependent variable is that health variable which we are interested in and the independent variable is our indicator of economic health, which this paper uses.

Economic Theory

To reiterate Hamermesh & Biddle, sleep is one part biological, one part choice. We all need sleep to live and function and generally feel well, but there is no set amount that everyone needs to sleep. The eight hours a day number is an average. The reality is that every single person has a different "biological" base amount that they need to sleep and then choose how much more to sleep on top of that.

So while one part of sleep is biological, the other part that is a choice variable; a good that is subject to the 24 hours a day time constraint. The amount of time that people sleep for this part is chosen based purely on utility maximization; the direct pleasure from sleep as well as its indirect effect on labor market productivity through alertness. This means that all the basic elements of choice theory and utility maximization apply to sleep just as it would to something more traditionally thought about, such as how much of a good one should purchase.

Particularly, the substitution and income effect apply to sleep as they would to anything else. The one hour increase in hours in a day that was observed in the Dutch windfall dataset is the equivalent of the income effect; everyone had their time budget constraint shifted out, and that led to higher consumption of sleep. Sleep is a normal good, and more time means higher consumption.

Those who are most sleep deprived, the women with children under 13, use the extra time almost exclusively for sleep.

Likewise, the economic theory behind in Colman & Dave and Asgeirsdottir et al. imply a substitution effect between sleeping minutes and time spent doing other activities. The recession in the US and Iceland respectively changed the lives of millions; many suddenly found themselves without a job and with free time. The loss of a job and the opportunity to earn some sort of wage **W** meant that the opportunity costs to sleeping and other activities had decreased. This means that the natural response of an individual who is maximizing utility is to sleep more all else equal. This happens again with Asgeirsdottir et al. when those who were in the mining business were found to sleep more after being laid off.

This analysis as well as that to be presented in this paper are important for understanding health issues. If healthy behaviors really are countercyclical, this could imply a need for new policy and general awareness of issues that arise during a growing economy. Understanding this trend and sleep time constraint is a piece in the puzzle of dealing with procyclical mortality rates. Additionally, finding differences among different race/sex groups is indicative that some may be more affecting by changes in aggregate economic conditions than other, and therefore we could expect greater behavioral changes from some groups over others.

Empirical Strategy

This analysis will expand off of Colman et al. (2013). We will use the exact same economic measure, the employment rate, and see how it affects sleep minutes for those in the ATUS. Unlike Colman & Dave, this analysis will expand to allow for interactions between the employment rate

and different subgroups based on race, sex, and age. These interaction terms will capture heterogeneity across different groups.

For example, if the coefficient on the employment rate were 2.2 and the coefficient on an interaction term between the race “Hispanic” and the employment rate were “2” then the total amount that a percent change in the employment rate would affect a Hispanic individual would be 4.2. A lowering of the employment rate is correlated with Hispanics sleeping more than their white counterparts, implying that changes in the economy affect Hispanics more than whites, that the ones losing their jobs or work hours are Hispanic.

So these interaction terms are indirect measures for which subpopulations are becoming unemployed during a recession. This measure is indirect; if the question was purely to know what the employment rate were by different races, that data can be found in a more straightforward way.

However, one advantage of measuring sleep is that it should pick up on underemployment. Underemployment implies that the individual would like to work more hours but is still employed. A possible scenario for many is that during recessions an individual’s company may reduce their hours out of necessity, leaving the person with new free time to allocate to non-market waking activity and sleep.

But the focus of this analysis is not to try and use sleep to measure underemployment. The goal is to expand on current literature that analyzes sleep for the sake of analyzing sleep and seeing how it responds to the economy across different subpopulations. The general equation for our analysis is the following.

$$Y_{ijdmt} = \beta X_{ijdmt} + \gamma E_{jmt} + \theta_m + \alpha_j + \lambda_d + \epsilon_{ijdmt}$$

The main variable of interest is the coefficient on **E**, the state employment rate in the month of the individual’s diary day. **X** is a vector for demographic information on an individual i in state j

on day d in month m and year t. These include age group, demographic group (broken up by race and sex), marital status, and education. $\boldsymbol{\alpha}$ is a state fixed effect. $\boldsymbol{\theta}$ is a month fixed effect while $\boldsymbol{\lambda}$ is a day fixed effect. $\mathbf{Y}$ is the amount of time in minutes that the individual slept on their diary day. All models used limit analysis to those between the ages of 25 and 55. The logic follows that of Colman et al. (2013) that those outside this age range are less likely to be affected by changes in the economy.

From this baseline model, we will construct various others that add interaction terms between the employment rate and subgroup characteristics. The explicit model for these interactions will be the following.

$$Y_{ijdmt} = \beta X_{ijdmt} + \gamma E_{jmt} + O E_{jmt} + K E_{jmt} + T E_{jmt} + \psi E_{jmt} + \Gamma E_{jmt} + \Lambda E_{jmt} + \Omega E_{jmt} + \theta_m + \alpha_j + \lambda_d + \epsilon_{ijdmt}$$

In this form of the model, we now allow for EPR to affect different subgroups heterogeneously. The coefficient $\boldsymbol{\gamma}$ now represents the effect of changes in the employment rate on white men ages 25 to 35. The subsequent variables are interactions between white women, black men, black women, other men, and other women with all these groups being ages 25 to 35. The final two variables, Λ and Ω, being interactions between the employment rate and those ages 35 to 45 and ages 45 to 55 respectively.

Data Description

All demographic and sleep time data comes from the American Time Use Survey (ATUS). The ATUS is an ongoing federally-administered survey on time use in the United States done with the goal of measuring how people divide up their daily activities. The sample space are all those who have completed the Current Population Survey (CPS). A random sample of those in that group

are selected to participate in the ATUS two months after completing the CPS. The data is cross sectional and covers the period from 2003 to 2014.

Those that agree to participate are given a phone interview, where they are asked very specifically what all the activities they participated in on the day prior to the interview were. The interviewees are told ahead of time what day they will need to record so as to get as detailed an answer as possible. The cutoffs for the full day questioned is 4:00am to 4:00am. All activities mentioned are given a six digit activity code that corresponds to what the main activity they were doing was. For example, the code for sleeping is, "010101," whereas the code for insomnia or sleeplessness is, "010102."

In addition to ATUS data, monthly state level employment rates were retrieved from the Bureau of Labor Statistics' (BLS) Local Area Unemployment statistics program. Figure 1 shows a time trend for both average national sleep minutes and the national employment rate.

It is pretty clear from the graph already that there is in fact a negative correlation between the employment rate and sleeping. The dip in the center of the graph indicated the 2008 Recession, where the EPR dropped dramatically and the average minutes spent sleeping increased. This graph already supports the notion that the two variables are negatively correlated. An issue to be aware of is that even prior to the 2008 recession, sleep minutes did seem to be rising. Controlling for time trends in some way should separate out the a general sleep time trend from the actual effect of the economy, though at the cost of removing variation in the data.

Other descriptive statistics also support our hypothesis that not only is sleep countercyclical but varies across different groups. Table 1 in the appendix shows different rates of employment and average sleep minutes for different subgroups in the ATUS. For the purpose of attaining a large enough sample size, the variable "other minorities" is used to describe all individuals who were not

listed as “White Only” or “Black Only”. The reasoning behind this was that the sample size became very small for these subgroups, to the point where some groups were less than five people.

The table already indicates that there is a heterogeneity across different races and sexes; women overall sleep more than men and black people sleep more than white and other minorities. The negative relationship thought to exist between sleep and economic conditions is pretty clear; the unemployed average 41 more minutes per night, which is huge in terms of health. Employment statistics don’t seem to very greatly among age groups; if anything it resembles a bell shaped distribution. Sleep however does go consistently down with age, for which I have no explanation.

Results

Table 2 has all the coefficients of interest from the regressions. For every regression the coefficient on EPR was negative and significant at the 1% level when year controls were not included. These values ranged from -1.850 in the baseline model which did not include any distinctions among subgroups to a smaller -1.466 in the model that allowed for differences for different race/sex groups and age groups.

The latter two regressions include a linear time trend and fixed effects respectively. In those models the coefficient on EPR no longer becomes significant. This is an indication that perhaps the first three models which did not include any controls for a time trend in sleep may have overestimated the coefficient on EPR. Including the year effects takes out much of the needed variation caused by the Great Recession, which affected all states.

Below the values for the EPR in every model are interaction terms between different subgroups and the EPR. None of the interactions were significant for any specification except for black women. The black women coefficient was significant at the 1% level for every specification of the model. This result indicates that while sleep minutes may be homogenously affected by most

groups, the data shows that black women are a noted exception. Changes in the employment rate affect sleep minutes for black women far more than they do for white males, or any other subgroup.

Table 3 contains subgroup total effects on the employment rate on different subgroups. The table shows that the effect of changes in the employment rate are non-significant for other men and other women. This result could be because of the way the variable was set up. Both subgroups are composed of those in the ATUS that did not file as “White Only” or “Black Only” when ask what their race was. Even with weighted observations, this group was much smaller than the white and black sample and composed of many different races. These reasons can explain the lack of significance. The table also shows in the column for model 5 that there is some evidence that white women and those ages 45 to 55 might be affected more than others by changes in the employment rate. These results are contingent on whether we use a linear time trend or year fixed effects, and because of these they should not be trusted.

Robustness of the results are tested in two ways. The first is through the use of a year linear trend and year fixed effects in models 4 and 5. As mentioned above, these variables take out the needed variation in the employment rate so that we can control for any general trend in sleeping. It discredits our results to see that the coefficient on EPR becomes nonsignificant when these controls are added in. However, it is noteworthy that even with the coefficient on EPR losing significance, the coefficient on black women stays significant and unchanged by the new specification.

The other test for robustness was the use of the unemployment rate (UR) instead of the EPR. Table 4 is a duplicate of table 2 but with the UR substituted for the EPR. In this table we see that the first two models have significant values for the coefficient on UR, and then allowing for variations in by age and then year controls wipe out the effect of the UR. The coefficients on all the interactions are now insignificant, implying that changes in the UR affected the sleep time of all

subgroup in the same way. This does not support the previous finding that black women are affected more than others.

Conclusions

The goal of this analysis was to expand on existing research and see if a heterogeneous effect of changes in the economy could be observed in the sleep patterns of different subgroups; and that is what was found. Black women were significantly more affected by changes in the employment rate than any other subgroup. As the employment rate rose, their sleep minutes decreased by anywhere from 2.685 minutes to 4.09 minutes depending on which model was being used. This heterogeneity was true regardless of what model was being used; even as the effect of changes in employment rate became insignificant for literally every other group, the coefficient on black women stayed significant.

The next step would be to see why. Why is it that black women are being so much more affected by changes in the employment rate? The data explains it all and can be summarized in the following.

1) Black women sleep minutes and employment is more variable than white men.
2) Sleep for black women is more responsive to economic conditions

The logic established in the introduction and literature review still hold here; employment and sleep minutes are negatively correlated. Black women have a more variable rate of both because whenever the economy gets worse, black women lose their jobs in higher rates than white men.

Figure 2 displays the employed percentage and sleep minutes calculates yearly for both white men and black women. It is visually apparent that the lines corresponding to white men are flatter than those for black women; while they still vary over time it is not nearly as much as their

black women counterparts. The black women lines show a sharp drop in employment during the Great Recession accompanied by a sharp increase in sleep minutes. This negative relationship between sleep minutes and employment is far easier to see in the lines for black women.

Like the research done before, this paper finds the countercyclical element to sleep time, and even finds evidence that black women are affected more by changes in the employment rate than other subgroups. This is the model picking up on the fact that the employment of black women in the sample was more variable than that of their white male counterparts. However, this result is not robust to which employment statistic is chosen, changing our metric to the unemployment rate did not yield this result.

There is still a lot of room to expand on this topic. Future research might look into potentially controlling for individuals that work in different industries and see how they respond differently to changes in the employment rate. Certainly we would expect industries that were harder hit by the recession to show more significant results than others. It also might be interesting to see what time trend in sleeping is going on, if any.

The best data we could have for really looking at the effect of employment on sleep minutes and overall health would be longitudinal data. It would be more powerful to have individual level data on the same person before and after gaining or losing a job. While expensive, this would be a more accurate way of measuring the effects of employment on health.

References

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Appendix

Table 1: Averages for Subgroups		
Group	**Average Sleep Minutes**	**Percent Employed**
White Men	517	69.15
Black Men	533	54.52
Other Men	531	69.59
White Women	525	54.09
Black Women	545	51.99
Other Women	531	55.68
Employed	508	-
Unemployed	549	-
Age 25-35	528	75.37
Age 35-45	512	78.22
Age 45-55	507	75.32

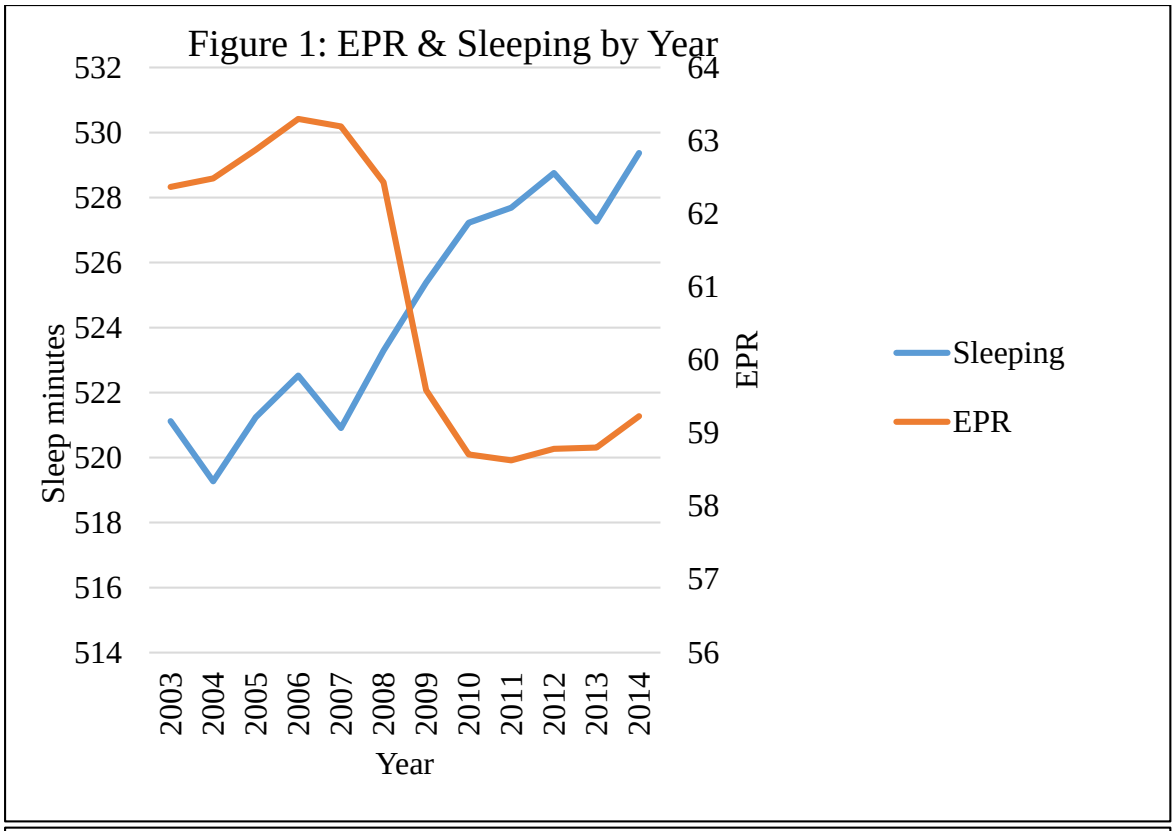
Table 2: EPR Regressions with Interactions					
Variables	Model 1	Model 2	Model 3	Model 4	Model 5
EPR	-1.850***	-1.540***	-1.466***	-0.135	-1.197
	(0.313)	(0.351)	(0.499)	(0.599)	(0.739)
The following are interaction terms between EPR and various subgroups.					
White Women	-	-0.330	-0.319	-0.312	-0.307
		(0.305)	(0.305)	(0.304)	(0.304)
Black Men	-	-0.482	-0.458	-0.484	-0.474
		(0.637)	(0.634)	(0.635)	(0.627)
Black Women	-	-2.553***	-2.535***	-2.551***	-2.516***
		(0.754)	(0.756)	(0.744)	(0.744)
Other Men	-	0.700	0.679	0.669	0.693
		(0.835)	(0.836)	(0.830)	(0.826)
Other Women	-	0.180	0.166	0.122	0.113
		(0.800)	(0.797)	(0.797)	(0.797)
Ages 35-45	-		0.215	0.233	0.227
			(0.436)	(0.434)	(0.433)
Ages 45-55	-	-	-0.398	-0.391	-0.393
			(0.372)	(0.372)	(0.373)
Linear Time Trend	-	-	-	1.080***	-
				(0.267)	
Year Fixed Effects	No	No	No	No	Yes
Observations	91,785	91,785	91,785	91,785	91,785
R-squared	0.091	0.091	0.092	0.092	0.092

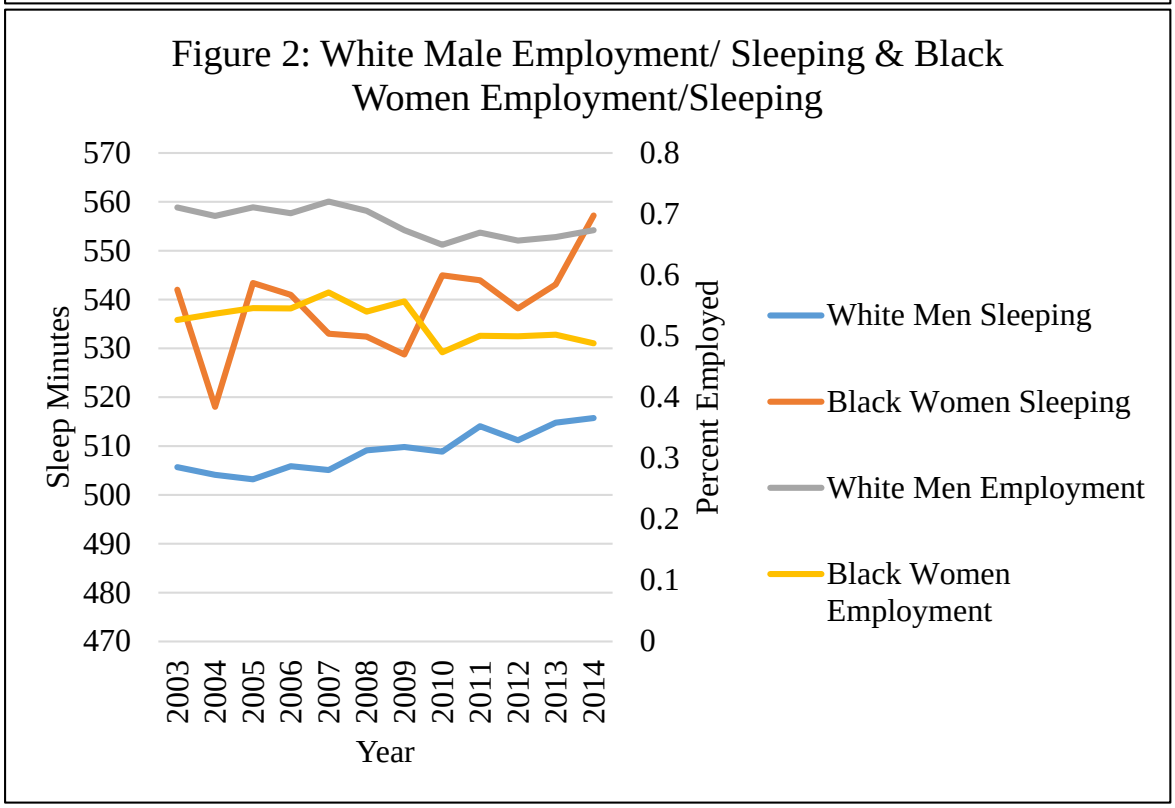
Note: The dependent variable is an individual's minutes spent sleeping. All regressions include controls for the different subgroups listed as well as marriage and education level. We also have fixed effects for day, month, and state. The sample size is limited to those ages 25-55. Age group 25-35 and the subgroup "White Males" are excluded because of multicollinearity. Standard errors are clustered by state. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Group Specific Total Effects					
Subgroup	Model 1	Model 2	Model 3	Model 4	Model 5
White Men	-1.850***	-1.54***	-1.466***	-0.135	-1.197
	(0.313)	(0.350)	(0.499)	(0.599)	(0.739)
White Women	-	-1.870***	-1.780***	-0.446	-1.503**
		(0.316)	(0.470)	(0.576)	(0.721)
Black Men	-	-2.020***	-1.923***	-0.619	-1.670
		(0.701)	(0.794)	(0.937)	(0.948)
Black Women	-	-4.090***	-4.000***	-2.685***	-3.710***
		(0.654)	(0.696)	(0.760)	(0.829)
Other Men	-	-0.840	-0.786	0.534	-0.503
		(0.849)	(0.947)	(1.035)	(1.130)
Other Women	-	-1.360	-1.300	-0.012	-1.080
		(0.844)	(0.934)	(0.996)	(1.090)
Age 25-35	-	-	-1.466***	-0.135	-1.120
			(0.499)	(0.599)	(0.739)
Age 35-45	-	-	-1.250***	0.099	-0.970
			(0.348)	(0.423)	(0.593)
Age 45-55	-	-	-1.864***	-0.526	-1.589***
			(0.396)	(0.558)	(0.669)

Table 4: UR Regressions with Interactions					
Variables	Model 1	Model 2	Model 3	Model 4	Model 5
UR	0.914**	0.860*	0.658	-0.535	0.482
	(0.313)	(0.422)	(0.494)	(0.835)	(0.792)
The following are interaction terms between UR and different subgroups					
White Women	-	-0.0580	-0.0588	-0.0733	-0.0673
		(0.521)	(0.518)	(0.515)	(0.513)
Black Men	-	0.321	0.322	0.331	0.322
		(1.373)	(1.372)	(1.369)	(1.350)
Black Women	-	1.815	1.821	1.770	1.766
		(1.147)	(1.149)	(1.128)	(1.143)
Other Men	-	-0.933	-0.927	-0.882	-0.926
		(1.318)	(1.305)	(1.298)	(1.295)
Other Women	-	-0.742	-0.738	-0.644	-0.694
		(1.376)	(1.366)	(1.353)	(1.344)
Ages 35-45	-	-	0.517	0.457	0.468
			(0.854)	(0.851)	(0.841)
Ages 45-55	-	-	0.0990	0.0779	0.0902
			(0.717)	(0.715)	(0.713)
Linear Time Trend	-	-	-	1.406***	-
				(0.205)	
Year Fixed Effects	No	No	No	No	Yes
Observations	91,785	91,785	91,785	91,785	91,785
R-squared	0.091	0.091	0.092	0.092	0.092

Note: The model used is the same as that in Table 2, but with EPR substituted with UR.





Note: Percent Employed is a weighted mean from the data collected in the ATUS. It is based on the ATUS data and not from EPR or the BLS.