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THE BUSINESS CYCLE AND HEALTH BEHAVIORS

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ABSTRACT

In this paper, we take a structural approach to investigate the effects of wages and working hours on health behaviors of low-educated persons using variation in wages and hours caused by changes in economic activity. We find that increases in hours are associated with an increase in cigarette smoking, a reduction in physical activity, and fewer visits to physicians. More importantly, we find that most of the effects associated with changes in hours can be attributed to the changes in the extensive margin of employment. Increases in wages are associated with greater consumption of cigarettes.

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Introduction

It is firmly established that sustained expansion of the economy can cure most economic problems. The expression "a rising tide lifts all boats" sums up the view that economic expansions provide greater opportunities for work, raise incomes and reduce poverty rates, especially for those socially and economically disadvantaged (Pigen & Wray 1998; Reich 1999; Barrington 2000; Wilson 2000; Freeman 2001; Freeman 2003; Davis & Bosley 2005). While it is clear that economic expansions provide widespread and immediate financial benefits, it is less certain whether economic expansions improve health. Intuition suggests that health would improve during good economic times because of rising incomes and decline during recessions because of falling incomes. However, as a recent article in the New York Times concludes "…the data on how an economic downturn influences an individual's health are surprisingly mixed" (Parker-Pope, Oct. 6 2008).

The conclusion of the New York Times article accurately reflects findings from previous studies of how the business cycle affects health behaviors and health. For example, Ruhm (2000), Neumayer (2004) and Gerdtham and Ruhm (2006) found that mortality decreased during recessions, but Tapia-Granados (2004), Economou et al. (2007) and Halliday (2006) reported the opposite. Similarly contradicting evidence is found in the literature concerned with the effects of economic activity on other measures of health such as highway fatalities, heart disease and obesity (Ruhm 1995, 2000, 2005, and 2007; Neumayer 2004; Gerdtham & Ruhm 2006; Economou et al. 2007; Tapia Granados 2005; and Bockerman et al. 2006). Finally, mixed evidence is also reported in studies of the effects of economic conditions on health behaviors (Ruhm 1995; Ettner 1997; Freeman 1999; Dee 2001; Ruhm & Black 2002).

Lack of consensus as to the effects of economic activity on health and health behaviors warrants additional study. More importantly, additional studies that identify the casual mechanisms through which changes in economic activity may affect health and health behaviors are needed. Most previous studies have taken a reduced form approach that relates health or health behaviors to measures of economic activity (e.g., unemployment).[1] However, economic activity itself is not a cause of changes in health; unemployment does not affect health. Rather it is changes in time use, income (wages) and other determinants of health that affect health or health behaviors. Therefore, greater insight into the issue can be gained from studying how economic activity affects these proximate causes of health (e.g., wages), and in turn, how these proximate causes affect health or health behaviors.

From both a scientific and public policy perspective, it is of more interest to understand why economic activity affects health or health behaviors than whether economic activity affects health. For example, if binge drinking increases during economic expansions, as indicated by some previous studies, is this because of an increase in income, or is it due to an increase in stress that comes from greater work intensity? The answer to this question matters because it is necessary to know the mechanism linking economic expansions to binge drinking if the goal is to

[1] Exceptions are Ettner (1997), Ruhm (2005, 2007), Charles and DeCicca (2008) and Barnes and Smith (2009). We discuss these below.

design appropriate public and private interventions to offset potentially harmful consequence of expanded economic activity (e.g., adverse health outcomes associated with binge drinking).

While previous studies have discussed potential causal mechanisms linking economic activity to health such as changes in wages, hours of work (leisure time availability), air pollution and vehicle miles traveled, none has tried to identify empirically the effect of these proximate causes on health or health behaviors.[2] This is the purpose of this study. Specifically, this paper examines the effects of changes in wages and working hours, which are associated with changes in economic activity, on health behaviors of low-educated persons. We focus on low-educated persons because both economic theory and empirical evidence suggest that the business cycle has the greatest impact on their wages and working hours (Oi 1962; Becker 1975; Bils 1985; Keane et al. 1988; Blank 1989; Blank 1990; Freeman 1990; Bartik 1994; Solon et al. 1994; Bartik 1996; Hoynes 1999; Ziliak et al. 1999; Bradbury 2000; Freeman 2001; Messemer 2004; Couch & Fairlie 2005, Charles & DeCicca 2008).

Estimates of the effects of wages and working hours on health behavior are obtained using a two-sample instrumental variables approach (TSIV). TSIV is an appealing approach because there are no large datasets that contain detailed information on wages, hours of work and health behaviors. The TSIV approach overcomes this data limitation. Further, the TSIV framework provides parameter estimates that are policy relevant. The TSIV procedure provides

[2] There are many studies that compare differences in health and health behaviors between employed and unemployed persons, but these studies fail to address the likely non-random nature of employment status. Indeed, it is this selection problem that motivates the study of aggregate economic activity on health behavior and health.

estimates of the effect of wages and hours on health behaviors for those whose wages and hours are altered by the business cycle.

Our results indicate that people are more likely to engage in unhealthy behaviors during economic expansions, namely increased cigarette smoking, reduced physical activity, and fewer physician visits. More importantly, our findings suggest that most of these effects are associated with the change in the extensive margin of employment—changes in employment status, rather than changes in hours of work for those who work. These findings imply that labor supply rationing associated with the business cycle may have substantial effects on health behaviors, at least in the short run, and these effects may be more important than business cycle induced changes in income.

Previous Literature: Economic Activity and Health Behaviors

Several recent studies have used local and regional variations in unemployment rates to examine the association between economic recessions and individual health behaviors such as alcohol use, cigarette smoking, physical activity and doctor visits. As noted above, this literature has not produced a consensus as to the effect of the business cycle on these behaviors.

Ruhm (1995) provided one of the earliest and most widely cited studies. He used state-level, aggregate data to study the effect of economic recessions on alcohol consumption and found evidence that alcohol consumption was pro-cyclical; alcohol consumption declined during economic recessions and increased during economic expansions. Using similar data, but with a different empirical strategy, Freeman (1999) confirmed the pro-cyclical variation of alcohol consumption. Using individual-level data from the Behavior Risk Factor Surveillance System

(BRFSS) from 1987-1999, Ruhm and Black (2002) also found evidence for the pro-cyclical alcohol consumption, as did Ettner (1997) who used individual-level data from the 1988 National Health Interview Survey (NHIS).[3] In contrast, Dee (2001), who used the BRFSS from 1984 to 1995, found evidence that the prevalence of binge drinking was strongly counter-cyclical. Furthermore, he argued that even among those who remained employed, binge drinking increased substantially during economic recessions. Finally, Charles and DeCicca (2008) found little evidence of cyclical changes in binge drinking behaviors. Their analysis used data from the NHIS from 1997 to 2001.

Studies of the association between aggregate economic activity and physical activity also yielded inconsistent evidence. Ruhm (2000, 2005) and Dustmann & Windmeijer (2000) reported evidence of counter-cyclical variation in individual physical activity; physical activity increased during recessions and decreased during expansions. Charles and DeCicca (2008), on the other hand, found that physical activity was independent of economic activity. In their study, they investigated the effect of economic activity on both moderate and vigorous exercise by education levels, and none of the estimates were statistically significant.

There has been less study addressing the effect of economic activity on smoking. Ruhm (2000, 2005) found evidence that cigarette smoking was pro-cyclical and that declines in use during recessions were disproportionately concentrated among heavy smokers. Charles and

[3] Johansson et al. (2006) examined the issue using individual-level data from Finland from 1982 to 2001. These authors also found pro-cyclical variation in alcohol consumption.

DeCicca (2008) also found evidence of pro-cyclical tobacco use.[4] However, according to a recent study by Barnes and Smith (2009), the probability of becoming unemployed resulted in greater continuation and resumption of smoking, which is suggestive of *counter*-cyclical variation in tobacco use.

Ruhm also investigated the association between economic activity and use of health care services such as doctor visits. Using data from the NHIS from 1972 to 1981, Ruhm (2003) reported that use of health care services such as hospital episodes and doctor visits was pro-cyclical, but the estimates were not statistically significant. Several studies in public health found the opposite when they compared employed and unemployed persons, which ignored likely selection into employment. For example, Linn et al. (1985) found that unemployed US veterans were more likely than employed to visit the doctor.

As this brief review highlights, there is a lack of consensus as to the impact of economic activity on health behaviors, which suggests that additional study is warranted. More importantly, additional studies that identify the causal mechanisms through which economic activity may affect health behaviors are particularly needed, as most studies have taken a reduced form approach that relates health behaviors to measures of economic activity (e.g., unemployment). Some efforts to estimate a more structural model have been made, but they are limited. Charles and DeCicca (2008) examined the effect of local unemployment rate on health behaviors and allowed the effect of unemployment to differ by those more or less likely to be

[4] Novo et al. (2000) examined the cigarette smoking behaviors among young men and women during economic expansion (1986) and recession (1994) in Sweden. These authors also found pro-cyclical variation in daily tobacco use.

employed (propensity of employment). Ruhm (2005, 2007) included aggregate working hours per week and personal income per capita in his primary specifications to indirectly assess whether the changes in incomes or leisure time help to explain the changes in lifestyle. Barnes and Smith (2009) examined how the probability of being unemployed affected smoking using an instrumental variables procedure.

Our study provides greater insight into the mechanisms linking the business cycle to health behaviors by examining the relationship between changes in wages and hours of work, which are a result of changes in economic activity, and changes in health behaviors. It is the first study to do this. The main objective of this study is to identify the casual effect of short-run, business cycle induced changes in income and hours of work (leisure) on health behaviors.

The Business Cycle and Health Behaviors

A simple, human capital model of the demand for health can be used to illustrate the potential mechanisms through which economic activity (e.g., recessions) may affect individual health behaviors (Grossman 1972; Grossman 2000). In this model, individual utility depends on current health status (*H*); a relatively time-intensive health-related commodity (*A*) such as physical activity; a less time-intensive health-related commodity (*C*) such as cigarette smoking; other consumption (*X*); and a vector of individual characteristics (Z_1) such as age, race/ethnicity, and education attainment.[5] Algebraically, utility is represented as follows:

$$U = U(H, C, A, X; Z_1) \quad (1)$$

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[5] The conceptual model is one of individual decision making and thus complications posed by inter-relationships between individuals living in the same household are ignored.

This is a static model that ignores dynamic aspects of investments in health.

In this model, health is produced by the individual according to a given production technology:

$$H=H(C, A, T_w; Z_1, Z_2, \varepsilon) \quad (2)$$

In equation (2), Z_2 are local environmental influences of health such as air quality or vehicle miles traveled. The health-related commodities *A* and *C* are inputs in the health production function, as is time spent working (T_w). Working hours may affect health because of stress associated with work, or because of psychological effects (e.g., depression) associated with changes in hours. Individual genetic (biological) endowments of health are denoted by ε.

In most simple models of the consumer, individuals face one budget (full income) constraint, but this assumes that individuals are able to freely choose working hours to maximize their utility. However, given our focus on the consequences of changes in economic activity, for example, recessions, it is more plausible to assume that individuals' working hours are rationed in the short run.[6] In other words, if individuals are not able to freely trade their time for money at the margin during economic recessions and/or economic expansions, the direct substitution of the time constraint into the budget constraint is no longer valid. We argue that this is particularly true in the short run, during economic recessions, as a portion of the population loses their job involuntarily during economic recessions.

[6] See Burtless & Hausman (1978), Ashenfelter (1980), Ham (1982), Killingsworth (1983), Kooreman & Kapteyn (1986), Bockstael, Strand & Hanemann (1987), Kooreman & Kapteyn (1987), and Prowse (2005) for formal discussions on labor supply under rationing.

Under such circumstances, the consumer has two constraints: a time constraint and a budget constraint. These are shown as follows:

$$T - T_w - t_c C - t_A A - t_X X = 0 \qquad (3)$$

$$WT_w + p_C C - p_A A - p_X X = 0 \qquad (4)$$

In equations (3) and (4), T is the fixed time endowment, T_w represents working hours, W is the wage rate, and t_i and p_i are fixed time and money inputs for per unit of commodities. We assume that $t_A > t_C$ because A is a time intensive commodity.

The Lagrangian condition can be expressed as:

$$\begin{aligned} L = & U[H(C, A, T_w; Z_1, Z_2, \varepsilon), C, A, X; Z_1] + \lambda(T - T_w - t_c C - t_A A - t_X X) \\ & + \gamma(WT_w - p_C C - p_A A - p_X X) \end{aligned} \qquad (5)$$

In this model, individuals maximize their utility by choosing the amount of commodities they consume subject to both constraints. First order conditions for these choices are:

$$\begin{aligned} &(a): \frac{\partial U}{\partial C} = \lambda t_C + \gamma p_C - \frac{\partial U}{\partial H}\frac{\partial H}{\partial C} \\ &(b): \frac{\partial U}{\partial A} = \lambda t_A + \gamma p_A - \frac{\partial U}{\partial H}\frac{\partial H}{\partial A} \\ &(c): \frac{\partial U}{\partial X} = \lambda t_X + \gamma p_X \\ &(d): T - T_w - t_c C - t_A A - t_X X = 0 \\ &(e): WT_w - p_C C - p_A A - p_X X = 0 \end{aligned} \qquad (6)$$

As shown in equations (6a) and (6b), health-related commodities *A* and *C* have both a direct and an indirect effect on utility. The indirect effect works through the effects of these commodities on health. The way we have written these first order conditions makes the indirect effect of consumption part of the marginal cost of consumption (i.e., right hand side of first order condition). For health-related commodities that positively affect health, for example, physical activity, the health effect of greater consumption of these goods lowers the marginal cost of consumption. For commodities that adversely affect health, for example, cigarette smoking, the health effect of greater consumption of these commodities raises the marginal cost. In general, the marginal benefit (utility) from greater consumption of these commodities is equal to the marginal cost, which includes the money and time price of consumption, and the health effect.

Solving the first-order conditions in (6) yields reduced-form demand functions for A, C, and X of the general form:

$$\begin{aligned} &Y_i = D_i(P_C, P_A, P_X, t_C, t_A, t_X, W, T_W, Z_1, Z_2, \varepsilon) \\ &i = A, C, X \end{aligned} \qquad (7)$$

Equation (7) indicates that the demand for health-related commodities (health behaviors A and C) will depend on prices (P_C, P_A, P_X), time inputs for consumption of A, C and X (t_C, t_A, t_X), wages (W), hours of work (T_w), personal characteristics (Z_1), environmental factors (Z_2), and the health endowment (ε).

To assess the impact of a recession, we focus on the two budget constraints in (6d) and (6e). Changes in economic activity may affect both the wage and hours of work. A change in the wage will have only an income effect because the consumer cannot (voluntarily) adjust hours in response to the wage change (by assumption, which is consistent with idea that hours are rationed in the short run). The absence of a price (substitution) effect associated with the wage implies that consumption of all commodities (normal goods) will be positively associated with the wage. So a recession that decreases wages (income) will result in a decline in consumption of A, C and X.

The business cycle will also affect hours. For example, a recession will decrease hours of work and income, even if wage rates remain unaffected. So the changes in hours may also be positively associated with consumption of A, C and X because of an income effect. However, a change in hours of work changes the time available for other consumption. A decrease in hours, for example because of a recession, will cause the consumer to increase their consumption of some commodities (i.e., reallocate their time spent in other consumption). This time effect may offset the decrease in consumption associated with the income effect of a decrease in hours, so the net effect on each commodity associated with changes in hours of work is ambiguous. Therefore, the impact of changes in time constraint depends on individual preferences and time spent on the consumption of these commodities.

The time-intensive nature of the good is likely to play a role. A decrease in hours of work is likely to be associated with an increase in consumption of goods that are relatively time intensive and a decrease in consumption of goods that are relatively less time intensive. In sum, this simple model predicts that changes in wages caused by changes in economic activity will be positively related to consumption of A, C and X (if they are normal goods), and that changes in hours of work (employment) caused by changes in economic activity may be positively or negatively related to consumption of A, C and X. For example, goods for which consumption is relatively time intensive will tend to increase during recessions and goods for which consumption is not time intensive will tend to decrease during recessions.

Empirical Model Specification

The empirical counterpart to equation (7) is given by the following:

$$HB_{ijt} = \alpha_j + \delta_t + X_{ijt}\gamma + Z_{jt}\lambda + \beta_1 HRS_{ijt} + \beta_2 WAGE_{ijt} + v_{ijt} \qquad (8)$$

In equation (8), health behavior (HB, for example alcohol) of person (i) depends on state (or MSA) effects (α_j), year effects (δ_t), personal and family characteristics denoted by *X*, and time-varying state (or MSA) specific characteristics (*Z*) such as state (or MSA) cigarette or beer prices. The two parameters of interest in equation (8) are those associated with the wage rate (*WAGE*) and hours of work per week (*HRS*).

The wage and hours of work are likely to be endogenous due to unobserved factors that affect labor market choices and health behaviors. For example, rates of time preference will determine both investments in human capital (wages) and health. To address this problem, we use an instrumental variables (IV) approach. We instrument for wages and hours using the state-specific (or MSA-specific) unemployment rate (*UNEM*) and industry mix (*IND*). Specifically, we estimate the following first stage regressions to obtain the instrumental variables:

$$\begin{aligned} &(a)\ HRS_{ijt} = \tilde{\alpha}_j + \tilde{\delta}_t + X_{ijt}\tilde{\gamma} + Z_{jt}\tilde{\lambda} + \beta_1 IND_{jt} + \beta_2 UNEM_{jt} + \beta_3 (UNEM_{jt} * IND_{jt} * AGE_{ijt}) + u_{ijt} \\ &(b)\ WAGE_{ijt} = \bar{\alpha}_j + \bar{\delta}_t + X_{ijt}\bar{\gamma} + Z_{jt}\bar{\lambda} + \gamma_{11} IND + \gamma_2 UNEM_{jt} + \gamma_3 (UNEM_{jt} * IND_{jt} * AGE_{ijt}) + e_{ijt} \end{aligned} \qquad (9)$$

In equations (9a) and (9b), the instruments for the wage and working hours are the unemployment rate (*UNEM*), industry mix (*IND*), and the interaction between unemployment, industry mix and age categories. Note that we have denoted reduced form parameters with the symbols ~ and -.

The IV approach is almost perfectly suited for the objectives of this study. Changes in hours of work and wages in response to changes in economic activity will yield estimates of the local average treatment effect (LATE) of wages and hours on health behaviors. This is exactly the effect of interest because the objective of this paper is to identify the causal mechanisms that link recessions (and expansions) to health behaviors. And this is exactly what the IV (LATE) approach yields. The challenge in this case is to justify the exclusion restrictions of the instrumental variables by appropriate use of conditioning variables.

As equation (7) indicates, prices of other goods may affect health behaviors and prices may be correlated with economic activity, which would violate the exclusion restriction. Unfortunately, in practice, it is difficult to measure many prices. However, prices of goods are determined primarily at the national level rather than at the local level. We control for national trends in prices using year fixed effects. Further, state or MSA level fixed effects are included in the regression model to control for time-invariant differences in prices across geographic locations. Therefore the major threat to the validity of the instruments is state (or MSA) time varying changes in prices. In order to address this issue, state cigarette and alcohol prices (or taxes) are included in all specifications, which are the most likely prices to change in response to changes in the economy given the prominent role of sin taxes in states' fiscal plans (e.g., Kubik & Moran 2003).

Changes in economic activity would also affect local environmental factors (Z_2), for example, air quality or vehicle miles traveled per capita, but these are unlikely to affect individual health behaviors. Nevertheless, in some models we include controls for these local time-varying factors so as to provide a sensible test for the exclusion restriction of instruments.

Finally, it is reasonable to assume that genetic endowments and time inputs per unit of commodities (t_i) are unrelated to changes in economic activity. Even if advances in technology change time inputs associated with consumption of goods, these advances in technology are unlikely to be correlated with changes in local economic activity. We recognize that there may be some ability for persons to alter the time spent consuming different commodities in response to changes in wages and hours of work, but data limits our ability to fully address this problem. In sum, while it is possible that omitted variables would render the exclusion restrictions non-valid, it is plausible that conditional on wages, hours of work and the variables just described, changes in economic activity as measured by our instruments are plausibly excludable from the health behavior models.

The efficacy of the IV procedure also depends on whether the instruments are sufficiently correlated with individual wage rates and working hours. Not surprisingly, there is considerable evidence that working hours (and employment) are highly correlated with local economic conditions. The strong positive association between local unemployment rates and working hours is quite mechanical since higher state unemployment rates suggest more people having zero working hours (the extensive margin of working hours). In addition, a substantial literature has documented that conditional on working, average working hours are also sensitive to local economic activities—the intensive margin of employment (Oi 1962; Freeman 1990; Hoynes 1999; Solon et al. 1994; Bartik 1996; Bradbuty 2000; Freeman 2001; Messemer 2004; Couch & Fairlie, 2005). For example, Bartik (1996) found that both wages and annual hours worked are correlated with local employment growth, and the effects are more pronounced for the low-educated.

The relationship between real wages and economic activity has been long debated. However, most studies of the issue find that real wages in United States are pro-cyclical, and this trend is more pronounced for the low-educated (Raisian 1983; Bils 1985; Keane et al. 1988, Blank 1989; Blank 1990; Freeman 1990; Blanchard et al. 1992; Solon et al. 1994; Bartik 1994; Abraham & Haltiwanger 1995; Bartik 1996; Hoynes 1999; Ziliak et al. 1999; Freeman 2001; Bowlus et al. 2002; Liu 2003; Messemer 2004).

Brechling (1967) suggests the local unemployment rates, at any given time, can be separated into two components: an industrial structure and a cyclical component. Therefore, the industry mix, as measured by the distribution of state employment by industry, can have a mediating influence on the effect of economic recessions on hours for work and income. Park and Hewings (2003) reported that 40 percent of the variation in state employment can be explained by the industry mix. In addition, Attaran (1986) found that state industrial diversity is highly associated with per capita income. Consistent with the theoretical and empirical evidence described above, estimates of the first stage, which are presented below, show a significant correlation between the instruments and individual wages and hours of work.

The interaction terms of local industry mix and unemployment rates in equations (9a) and (9b) are meant to capture the different responses in labor demand of various industries when they confront same changes in local economic activity. Substantial evidence has been provided to show that local industry mix can have a substantial effect on the cyclical sensitivity of unemployment rates (Van Duijn 1975; Browne 1978a; Browne 1978b; Hyclak & Lynch 1980; Forrest & Naisbitt 1988; Malizia & Ke 1993; Park & Hewings 2003; Moscarini & Postel-Vinay 2009). One of the possible explanations is that industries in a diverse economy may experience fluctuations at different severity and timing (Malizia & Ke 1993). For example, the labor demand of the manufacturing sectors may be more sensitive to economic recessions and response quicker than the services sectors (Park & Hewings 2003) or labor demand of large firms is more sensitive than that of small ones to economic recessions (Moscarini & Postel-Vinay 2009). As a result, employment gains in some industries may mute the reductions of employment in other industries so as to serve as a buffer to general changes in economic activity

We allow the effect of unemployment by industry to differ by age. This specification is motivated by the theoretical and empirical literature that has documented that the cyclical volatility of hours of work is U-shaped as a function of age (Becker 1975, Clark & Summers 1981, Ríos-Rull 1996, Gomme, et al. 2004, Hansen & Imrohoroglu 2007, Jaimovich & Siu 2009). The employment and hours of work of the young are much more variable than that of prime-aged people over the business cycle, while those closer to retirement ages experience the volatility somewhere in between. For example, Jaimovich and Siu (2009) have shown that when averaged across G7 countries the standard deviation of cyclical employment fluctuations for the 15 to 19 years old was nearly six times greater than that of the 40 to 49 years old. Similarly, the average employment volatility of the 60 to 64 years old was about three times greater than that of the 40 to 49 years old.

Sample Selection Bias

As is well known, analyses of the determinants of wages usually face a potential bias because wages of those not working are unobserved. Often this is referred to as a sample selection bias—those who work are not a random sample of the population (Heckman 1979). In this research, the selection issue is minimized because we focus on a sample of men in prime working age (25 to 55). More importantly, the conceptual model is one in which there are no substitution effects associated with the wage. Consumers are involuntarily off of their labor supply curve because of changes in economic activity. Therefore, the wage only has an income effect. This implies that the correct measure to use is the observed wage including zeros.

Other Statistical Issues

Due to data limitations, estimates of the effects of wage and hours of work on health behaviors are obtained by using the two-sample instrumental variables approach (TSIV). This approach has been used in previous studies that faced similar data limitations (Bjorklund & Jantti 1997; Currie & Yelowtiz 2000; Dee & Evans 2003; Borjas 2004: Kaushal 2007). This is also an appealing approach for the study because, as far as we know, there are no publicly available data that contain detailed information on income, hours of work, and health behaviors. The TSIV approach is able to overcome this data limitation. Specifically, the determinants of wage and hours of work per week in the first stage (equation 9a and 9b) are estimated by using samples from the Current Population Survey. In the second stage, the effects of changes in these factors on health behaviors are obtained by including the predicted values of wages and hours per week for the samples from the Behavioral Risk Factor Surveillance System and the National Health Interview Survey. A more detailed description of data is provided in the next section. Standard errors in the second stage need to take into account the predicted nature of these variables. Here, we obtain standard errors by bootstrapping method.

Data

Data for the study come from the Current Population Study (CPS), the Behavioral Risk Factor Surveillance System (BRFSS) and the National Health Interview Survey (NHIS). The CPS is used to estimate the effects of economic activity on wages and working hours. The BRFSS and the NHIS are used in the second stage to estimate the effect of wages and working hours on health behaviors. Demographic variables common to all three datasets include respondents' education attainment (less than high school, high school graduate, some college), family structure (married, single and other), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic), and age. The sample is limited to males ages 25 to 55 with some college education or less. We focus on low-educated persons because of their greater labor market sensitivity to the business cycle.

Behavioral Risk Factor Surveillance System

Data on health behaviors from the BRFSS are from years 1984 to 2005. The BRFSS is administered by the Centers for Disease Control and Prevention. The BRFSS is an on-going annual telephone survey of persons age 18 and over. Fifteen states participated in the survey in the starting year, 1984, and this number grew to 33 in 1987, 45 in 1990, 50 in 1994 and all 51 states, including Washington, DC in 1996.[7]

Three health behaviors are derived from the BRFSS: cigarette smoking, alcohol use, and physical activity. Two measures of cigarette consumption are constructed: one dichotomous variable for the extensive margin of use, current smoker, and one for the intensity of use: an

[7] To address concerns about the unbalanced panel data in BRFSS, since early waves only contain data from 15 states, we replicate our estimates with BRFSS data from 1987 to 2005. Estimates are discussed below.

indictor for smoking 20 or more cigarettes per day. Those who never smoked or who smoked less than 100 cigarettes in their lives have a value of zero. Three measures of alcohol use are constructed: any alcohol use in the last 30 days, any binge drinking (five or more drinks per occasion) in the last 30 days, and an indicator for having 60 or more drinks in the last 30 days, which captures participation in "chronic" drinking (Dee 2001; Ruhm and Black 2002). Measures of physical activity from the BRFSS are not consistent throughout the time period. For this reason, we adopt a dichotomous indicator, physical activity, which is equal to one if the respondent reported any physical activity or exercises in last 30 days. Table 1 presents the summary statistics for the samples from the BRFSS from 1984 to 2005.

National Health Interview Survey

The National Health Interview Survey (NHIS), which is conducted by National Center for Health Statistics (NCHS), is designed to be the major source of information on the health of the civilian non-institutionalized population of the U.S. Because the smallest geographic identifiers available in the NHIS public used data are large metropolitan statistical areas (MSAs), the NHIS samples used for the empirical analysis are limited to those from these MSAs, as are the matched CPS samples from 1976 to 2001.[8]

The NHIS is used to obtain measures of health care use. We use the number of doctor visits in the past 12 months.[9] The measures of doctor visits, while extremely useful, are worthy

[8] More recent information could not be used, however, because geographic identifiers (beyond the census region) have been omitted from the public-use files after 2001.
[9] The wording of this question changes during this time period. From 1976-1996, the respondents were simply asked about "doctor visits in past 12 month", In the waves from 1997-1999, the respondents were directed to report their visits to both doctor and other health care professionals about their own health. Moreover, they were asked to exclude their hospital overnights, visits to emergency rooms, home visits and

of some discussion. Changes in number of doctor visits are associated with behavioral responses, for example people may reduce their doctor visits when facing tight work schedules. However, doctor visits also reflect health, which may change with the business cycle. One strategy to address this issue would be focusing on whether a person had few visits, which may minimize the influences from health status. Therefore, in this study, we create two dichotomous variables for doctor visits in the past 12 month, having any doctor visits (the variable equals one if the respondent had one or more doctor visits in the past 12 months) and having two or more doctor visits (the variable equal one if the respondent had two or more doctor visits in the past 12 months). Table 2 presents the summary statistics for the samples from the BRFSS from 1984 to 2005 and the NHIS from 1976 to 2001.

Current Population Survey

The CPS March file is widely used in economic studies of wages and hours. The key variables used in this study are individual wage rate and hours of work per week. The wage rate is constructed from information on wage and salary income, weeks worked and usual working hours per week in the preceding year.[10]

Unemployment Rates and Industry Mix

The indicators for local economic activity are the annual state- or MSA-specific unemployment rate and industry mix (the distributions of employment by industry) for the

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telephone calls. Since 2000, the respondents were told specifically to exclude dental visits, in addition to the exclusions above.

[10] All nominal monetary terms are converted to 1982-1984 U.S. Dollars using the all-items consumer price index.

civilian non-institutionalized population (aged 16 years and over).[11] Measures on annual state unemployment rates and state industry mix come from BLS and the Bureau of Economic Analysis (BEA), while unemployment rates and industry mix for large MSAs from1975 to 2000 come from CPS March file.[12] State industry mix from 1983-2004 is constructed as the percentages of wage and salary disbursements paid by industry, which is provided by the BEA in Regional Economic Accounts, while state unemployment rates for the same time period come from the BLS Local Area Unemployment Statistics (LAUS) Database.[13]

Cigarette and Alcohol: Prices and Taxes

In order to control for changes in tobacco and alcohol prices we include cigarette taxes, cigarette prices, beer taxes, and beer prices in the regression models. Data on state cigarette taxes and prices from 1976 to 2005 are from the Tax Burden on Tobacco (Orzechowski & Walker 2006). Cigarette prices are weighted average prices per package in a state. Data on state beer taxes for the same time period comes from various issues of the U.S. Brewers' Association Brewer's Almanac, while state beer prices come from the Cost of Living Index (COLI), which is published quarterly by the American Chamber of Commerce Researchers Association (ACCRA 1984–2003). State annual beer prices generated from ACCRA are averaged prices of surveyed

[11] In Standard Industrial Classification (SIC), there are 11 SIC industry divisions, including Agriculture, Forestry, and Fishing; Mining; Construction; Manufacturing; Transportation, Communication and Public Utilities; Wholesale Trade; Retail Trade; Finance, Insurance, and Real Estate; Services; and Public Administration.[11] In this study, we collapsed the wholesale trade industry with the retail trade industry.

[12] Because unemployment rates at large MSAs provided by the BLS only go back to 1990s and industry mix generated from the BEA Regional Economic Accounts can only go back to 1998, annual unemployment rates and industry mix for the large metropolitan areas from 1975 to 2000 are generated from CPS, using both male and female individual observations aged from 18 to 70.

[13] See (http://data.bls.gov/PDQ/outside.jsp?survey=la.. Since individual wage and salary income and hours of work reported in the CPS March file are from the preceding year (t-1), we match the state unemployment rates and the distribution of employment by industry from the preceding year (t-1) to these measures.

cities in a state.[14] Data on cigarette and beer taxes in the large metropolitan areas from 1976-2001 are constructed from state taxes, weighted by the proportion of the MSA population in each state, if applicable.[15]

Vehicle Miles Traveled, Highway Fatality and Air Pollutants

State vehicle miles traveled per capita (VMT) from 1984 to 2005, as well as highway fatalities and air pollution measures in large MSA levels from 1976 to 2001 were also obtained. These variables are included in some regression models to control for local time-varying factors and to assess the exogeneity of the instrumental variables. Specifically, state VMT per capita is provided by National Center for Statistics and Analysis (NCSA) of National Highway Traffic Safety Administration (NHTSA). The annual county-level highway fatality data comes from the Fatality Analysis Reporting System (FARS), NCSA, while the county-level air pollutant measurements are constructed from annual summaries of key measurements from each monitor

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[14] Creating state level measures of beer prices from ACCRA may be subject to measurement error. First, COLI is designed to provide measures of living cost differences among urban areas. Therefore, state rural areas are not included for this survey. Second, survey areas of COLI change from quarter to quarter since city's chamber of commerce may not consistently agree to participate the survey. As a result, COLI is not able to provide a national or even state representative sample across the years. In addition, data collection vary brands, packs, containers, and excluding container deposits.

[15] The NHIS changed MSA definitions in 1984 and 1995 and the CPS changed their MSA definitions in 1985 and 1996 to accommodate the revisions of the MSA definitions by the Office of Management and Budget. In addition, some large metropolitan areas may cross state borders; 13 out of the 46 MSAs in our sample contain counties from different states during 1995 to 2001. In that case, the population weighted MSA cigarette or beer taxes are created, by using the 1990 state population living in these MSAs as weights. Consequently, the population weights of a MSA may be different during the three time periods, 1976-1984, 1985-1994 and 1995-2001, due to the changes in the metropolitan area definitions. Specifically, we generate the MSA taxes for cigarette and beer using the following equation: $MTax_{jtk} = \sum_{i=1}^{n}\left[\left(p_{ik}/p_{jk}\right)STtax_{it}\right]$, where MTax denotes the population weighted taxes in MSA j, year t and time period k, Pik is the population from 1990 census in state i living in MSA j at period k, Pjk is the population of MSA j at period k, STtax is the state taxes for cigarette or beer in state i and year t. k stands for three time periods (1976-1984, 1985-1994 and 1995-2001) with different MSA definitions.

provided by AirData, U.S. Environmental Protection Agency (EPA).[16] By using the similar procedure as creating the population weighted MSA taxes, the county-population weighted MSA highway fatalities and air pollutions are generated, which are included in the analysis at large MSA level.

TSIV Results

The primary goal of this paper is to obtain estimates of the effect of wages and working hours on health behaviors using the variations in these factors caused by changes in economic activity. To obtain estimates that can be plausibly interpreted as causal effects, we adopt a TSIV approach. Specifically, local unemployment rates and industry mix are the instrumental variables for wages and working hours. Estimates from the first stage (equations 8a and 8b) are provided in Appendix Table 1. Specifically, the appendix table show estimates associated with the instruments from models predicting wage rates and hours of work using the CPS for years 1984 to 2005 (BRFSS analysis) and 1976 to 2001 (NHIS analysis). At the bottom of Appendix Table 1, partial F-statistics for the excluded instruments are presented. Estimates indicate that both state (or MSA) unemployment rates and industry mix are significant determinants of wage rates and hours of work per week of the low-educated, with the joint F-statistics between of 6.9 and 26.4 depending on the sample.[17]

[16] The annual summaries provided by AirData include five "criteria" pollutants, carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO2), lead (Pb) and total suspended particulates (TSP). we focus on CO level during this time period in this study, since previous studies suggest that high level of CO is associated with infant mortality, school absences and asthma (Neidell 2004; Currie & Neidell 2005; Currie et al. 2009). We also take sensitivity analyses on ozone, which provide the same results.

[17] Since the variables associated with the number of cigarettes smoked are only available from 1984 to 2000, a separate set of first stage regressions is performed to accommodate the requirement of TSIV. The joint F-statistics of 8.4 and 23.8 are obtained for the equation of wage rates and hours of work respectively and for the sub-sample, they are 7.7 and 11.8.

Panel A in Table 3 presents our primary estimates of the effects of wages and hours of work on health behaviors. The first three columns in Panel A provide strong and consistent evidence that both wages and hours of work are positively associated with cigarette smoking. These estimates are obtained using linear probability models. The results in column 1 suggest that a one-dollar increase in the real wage rate is associated with a 1.2 percentage point increase, corresponding to 3.5-percent, in smoking prevalence. On the other hand, a one hour increase in hours of work per week is associated with a 0.8 percentage point (two percent) increase in smoking prevalence. Moreover, the results in columns 2 and 3 indicate that both wage and hours of work are also associated with smoking intensity. A one-dollar increase in the real wage rate is associated with an increase in the probability of having 10 or more cigarettes daily of 0.5 percentage points, and one hour increase in hours of work per week is associated with an increase in the probability of having 10 or more cigarettes daily of 1.9 percentage points. These estimates are consistent with findings from Ruhm (2000, 2005) and provide evidence that cigarette smoking is pro-cyclical.

Columns 4 through 6 in Panel A present estimates of the effects of wage and hours of work on alcohol use and abuse. We do not find evidence that wages and working hours have significant impact on alcohol use or “chronic” use. Both point estimates and statistical significance are quite small for the drinking participation and intensity measures. The effect of working hours on binge drinking participation is the exception. The results suggest that working hours are negatively associated with binge drinking participation, although the magnitude is quite small; a one hour increase in hours per week is associated with a 0.4 percentage point decrease in probability of binge drinking.

The effects of wage and hours of work on leisure time physical activity is reported in column 7. Admittedly, this is a limited measure of physical activity. Estimates indicate that longer working hours are negatively associated with physical activity participation. The effect, however, is quite small, given the fact that over 70 percent of the sample had some kind of leisure time exercises in the past month. The probability of engaging in any physical activity in past month would decline by 0.4 percentage points, a corresponding 0.6% reduction, if the average working hours per week increased for an hour. In general, our estimates provide evidence suggesting a counter-cyclical variation in physical activity, which is consistent with findings in Ruhm (2000, 2005) and Dustmann & Windmeijer (2000). In addition, we show that such impact on physical activity mainly due to time effect, rather than income effect.

Estimates associated with doctor visits in the preceding year are presented in last two columns of Table 3. No wage effect is found for both measures. Estimated wage effects are small and statistically insignificant. On the other hand, estimates of the effects of working hours suggest that the number of doctor visits in the preceding year is negatively associated with working hours. Specifically, estimates indicate that one extra working hour per week would decrease the probability of having at least one doctor visit in the past 12 months (having two or more doctor visits) in the preceding year by 1.5 (3.0) percent. These effects are relatively large and statistically significant. They indicate that the number of doctor visits exhibits a counter-cyclical variation.

In sum, the results in Panel A of Table 3 suggest that changes in both the wage and hours of work associated with local economic activity have significant associations with health behaviors. Specifically, estimates indicate that both doctor visits and leisure-time physical activity are counter-cyclical mainly because of changes in working hours, while both cigarette smoking prevalence and smoking intensity exhibit pro-cyclical variation, which are affected by changes in income and hours. More importantly, these findings suggest that the effects of changes in working hours may have different influences on time-intensive behaviors such as binge drinking, visits to physician and physical activity than on less time-intensive behaviors such as cigarette smoking.

In order to distinguish between effects of changes in hours of work on the extensive margin of employment from the total effect of hours (extensive and intensive), we replaced hours of work with a dichotomous indicator of employment status, and re-estimated the models in Panel A of Table 3. These estimates are reported in Panel B. By comparing estimates of changes in employment status with estimates of changes in average working hours, we can identify which aspect (intensive or extensive) of hours of work is associated with health behaviors. In Panel C of Table 3, the effect of a 2.5-percent change in employment is also reported. This is relevant because the average hours of work per week are approximately 40. Thus, a one-hour change in average working hours can be brought about by a 2.5-percent change in total employment (and no change in hours for those who work). In this case, the effect from changes of the extensive margin of employment (changes in employment status) can be separated from the effect associated with changes of the intensive margin of employment (changes in hours of work).

Estimates of the effect of employment status in Panel B have the same signs and pattern of statistical significance as estimates of hours of work in Panel A. Moreover, a comparison of estimates in Panel C with those in Panel A indicate that, on average, a 2.5 percent increase in individual employment is associated with the same magnitude of changes in health behaviors as a one hour change in average hours of work per week. Specifically, a 2.5 percent increase in employment is associated with:

- an increase in smoking participation (cigarette smoking intensity measures) of 1 (2-2.5) percentage point;
- a decrease in binge drinking participation of 0.2 percentage points;
- a decrease in leaisure time physical activity of 0.5 percentage points;
- and a decrease the any and number of doctor visits of 1.5 percentage points.

By comparing these estimates with the estimates of an extra hour of work in Panel A, it is clear that changes in individual employment status are the major reason for changes in health behaviors during economic fluctuations.

Sensitivity Analyses

Sensitivity analyses have been performed in order to investigate the robustness of our primary findings.[18] Estimates from the alternative specifications for the BRFSS samples are reported in Table 4. The first analysis addresses potential concerns about the exogeneity of the instrumental variables: state unemployment rates and industry mix. Because state and year fixed

[18] In an analysis not presented, we replaced cigarette and beer taxes with prices, and result were same as reported in Table 3. In anther analysis, we limited BRFSS sample to post 1987 to address the concern about the unbalanced panel of the BRFSS. Again, we obtained similar estimates as in Table 3.

effects are controlled in all specifications, the primary threat to the instrument variables comes from potentially unmeasured time-varying state level effects that may affect health behaviors of the low-educated are correlated with changes in unemployment rates and industry mix. This issue is investigated by adding state vehicle miles traveled (VMT) per capita to the primary specification. The estimates of wage or hours of work per week should not change with the inclusion if the instrumental variables are exogenous. In fact, this is the case. As estimates in Table 4 indicate, estimates of wages and working hours are basically unchanged from those in Table 3 when state VMT per capita are included in the model. More importantly, this finding is not because VMT is not significantly associated with the dependent variable, it is, but because it is more or less uncorrelated with the instrumental variables. Thus, the results from these alternative specifications provide evidence to support the identification strategy.

Alternative specifications for the NHIS sample are also presented in Table 4 (columns 8 and 9). Two additional covariates representing time varying factors in these large MSAs are included: population weighted highway fatality per capita and population weighted ozone levels in these metropolitan areas. Again, estimates in Table 4 are very similar to those in Table 3. Importantly, highway fatality per capita is highly significant, which provides additional evidence supporting the exogeneity of the instruments.

Summary and Discussion

Previous studies provide mixed evidence on the effect of economic expansions or recessions on health behaviors, and most of these studies take a reduced form approach. We extend the existing literature by taking a more structural approach. We examined the effects of wages and working hours on health behaviors of the low-educated using variations in these factors caused by changes in local macroeconomic activity. We used a two-sample instrumental variables approach to overcome data limitation and to provide estimates that can be possibly interpreted as causal.

We find evidence that economic expansions are associated with an increase in unhealthy behaviors; an increase in cigarette smoking, a reduction in physical activity, and fewer visits to physicians. More importantly, we find that changes in hours of work have different associations with time-intensive and less time-intensive goods Specifically, increases in working hours result in greater consumption of cigarettes, which is a less time-intensive good, at both the intensive and extensive measures, while increases in working hours have significantly negative impacts on physical activity and doctor visits, which are consumption of time-intensive goods. We also find that increases in wages lead to higher consumption of cigarettes, We find little evidence of an association between employment (including both wages and working hours) and alcohol consumption among the low-educated. All these findings are robust to alternative specifications including adding additional state-specific (or MSA-specific) time varying controls. In addition, we find that most of the effects associated with hours of work can be attributed to the changes in the extensive margin of the employment rather than the intensive margin of hours of work.

An important implication of our findings is the apparent inability to smooth leisure consumption over the business cycle and its effects on health behaviors of the low-educated. Our results reveal that changes in employment associated with local economic activity, rather than changes in income, has the most important impacts on health behaviors. These findings imply that labor supply rationing of the low-educated during economic recessions or expansions may have substantial effects on their health and health behaviors in the short run.

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Table 1. Summary Statistics of the BRFSS sample: 1984-2005

	Mean	Standard Deviation
Current Smoker	35.1	47.7
Having 10 or more cigarettes	30.4	46.0
Having 20 or more cigarettes	22.5	41.8
Any Alcohol Use	61.8	48.6
Any Binge Drinking	27.0	44.4
Having 60 or more Drinks	9.7	29.6
Any Physical Activity	71.1	45.3
Real Wage Rate	8.6	2.0
Hours of Work per Week	42.0	2.8
Less Than High School	15.6	36.3
High School	46.1	49.8
Some College Education	38.3	48.6
Non-Hispanic White	79.3	40.5
Non-Hispanic Black	8.8	28.3
Hispanic	12.0	32.5
Age	39.1	8.6
Married	65.4	47.6
Other	15.8	36.4
Single	18.9	39.1
Number of Observations	460,841	

Notes: Data are from 1984 to 2005 years of the BRFSS. Samples are limited to non-disabled male respondents aged 25-55 with some college education or less. Real wages rates and hours of work per week in BRFSS are predicted by using estimates from CPS samples in the first stage.

Table 2. Summary Statistics of the NHIS Sample: 1976-2001

	Mean	Std. Dev.
Any Doctor Visits	64.1	48.0
Two or More Doctor Visits	38.3	48.6
Real Wage Rate	8.6	2.7
Hours of Work per week	39.1	4.1
Less Than High School	24.0	42.7
High School	46.0	49.8
Some College Education	30.0	45.8
Non-Hispanic White	65.1	47.7
Non-Hispanic Black	15.7	36.4
Hispanic	19.2	39.4
Age	38.4	8.8
Married	71.6	45.1
Others	10.9	31.1
Single	17.5	38.0
Number of Observations	147,965	

Notes: The NHIS samples are from waves of 1976 to 2001. Samples are limited to non-disabled male respondents aged 25-55. Real wages rates and hours of work per week in BRFSS are predicted by using estimates from CPS samples in the first stage. In addition, NHIS samples are restricted to large MSAs due to the limitation of geographic identifiers in the public used data.

Table 3. Effects of Wages and Working Hours on Health Behaviors

	Current Smoker	Smokes 10 or More Cigarettes [a]	Smokes 20 or More Cigarettes [a]	Any Alcohol Use	Any Binge Drinking	Having 60 or more Drinks	Any Physical Activity	Any Doctor Visits	>2 Doctor Visits
Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Wages	0.012***	0.005**	0.004*	-0.004	-0.002	-0.002	-0.001	-0.002	-0.001
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.002)
Hours of Work	0.008***	0.019***	0.020***	-0.002	-0.004*	-0.001	-0.004**	-0.010***	-0.012***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Panel B									
Wages	0.014***	0.008***	0.007***	-0.006*	-0.003	-0.002	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.002)
Employment	0.348***	0.883***	1.047***	0.034	-0.075	-0.018	-0.189	-0.586***	-0.611***
	(0.117)	(0.142)	(0.124)	(0.158)	(0.147)	(0.079)	(0.176)	(0.139)	(0.119)
Panel C									
Effect of 2.5% Increase Employment	0.009	0.022	0.026	0.001	-0.002	-0.000	-0.005	-0.015	-0.015
Mean	0.351	0.304	0.225	0.618	0.270	0.097	0.711	0.641	0.383
Number of Obs.	460,841	259,315	259,315	390,295	385,659	383,018	390,769	146,536	147,965

Notes: Bootstrapped standard errors, calculated assuming that observations are independent across years and states but not within states in a given year, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All regressions contain controls for demographic variables, including education, age, race/ethnicity, and marital status. Other covariates include *local cigarette and beer taxes*, state (or MSA) and year fixed effects. (a) Variables associated with number of cigarettes smoked daily are only available from 1984-2000.

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Table 4. Effects of Wages and Working Hours on Health Behaviors: Sensitivity Analyses

	Current Smoker	Smokes 10 or More Cigarettes [a]	Smokes 20 or More Cigarettes [a]	Any Alcohol Use	Any Binge Drinking	Having 60 or more Drinks	Any Physical Activity	Any Doctor Visits	>2 Doctor Visits
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Wage	0.012***	0.006**	0.005**	-0.004	-0.001	-0.001	-0.002	-0.002	-0.001
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.003)
Hours of Work	0.008***	0.019***	0.020***	-0.002	-0.004**	-0.001	-0.004*	-0.011***	-0.013***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
VMT per capita	0.001**	0.001**	0.001	0.000	0.001***	0.000**	0.001**	-	-
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	-	-
Highway Fatality	-	-	-	-	-	-	-	0.000***	0.000**
	-	-	-	-	-	-	-	(0.000)	(0.000)
Ozone	-	-	-	-	-	-	-	0.228	0.365
	-	-	-	-	-	-	-	(0.283)	(0.314)
Number of Obs.	460,841	259,315	259,315	390,295	385,659	383,018	390,769	146,536	147,965

Notes: Bootstrapped standard errors, calculated assuming that observations are independent across years and states but not within states in a given year, are reported in parentheses. *** *p*<0.01, ** *p*<0.05, * *p*<0.1. All regressions contain controls for demographic variables, including education, age, race/ethnicity, and marital status. Other covariates include *local cigarette and beer taxes*, state (or MSA) and year fixed effects. (a) Variables associated with number of cigarettes smoked daily are only available from 1984-2000.

Appendix Table 1. First Stage Estimates Using the CPS Samples

	For the BRFSS samples from 1984 to 2005		For the NHIS samples from 1976 to 2001	
	Wage Rates	Hours of Work	Wage Rates	Hours of Work
Construction	15.062	13.759	73.197	68.188***
	(12.889)	(8.949)	(76.228)	(22.424)
Financial	-2.607	13.166**	127.752	10.442
	(9.131)	(6.531)	(130.004)	(16.667)
Manufacturing	-5.111	4.074	120.910	25.471*
	(8.520)	(5.168)	(123.857)	(13.746)
Mining	30.021*	20.309*	93.289	19.514
	(17.610)	(10.741)	(100.829)	(14.592)
Trade	12.836	20.563***	103.243	15.747
	(21.754)	(7.803)	(111.541)	(14.198)
Transportation & Utilities	-20.377	-0.264	97.927	16.861
	(20.969)	(10.958)	(105.736)	(14.243)
Agriculture	-32.699	-42.737	104.476	22.473*
	(69.610)	(33.472)	(106.567)	(13.407)
Services	-3.930	0.499	108.253	9.485
	(9.685)	(5.624)	(116.399)	(15.092)
Unem.*Pub.*Age4	0.650	-0.460	12.425	2.726
	(0.499)	(0.441)	(10.537)	(2.470)
Unem.*Con.*Age4	1.282	-2.207*	6.848	-5.791**
	(1.602)	(1.317)	(5.449)	(2.937)
Unem.*Fin.*Age4	0.483	-1.381*	-2.762	0.478
	(0.809)	(0.748)	(3.240)	(1.533)
Unem.*Man.*Age4	1.023**	0.480**	-0.535	-0.378
	(0.480)	(0.240)	(0.762)	(0.268)
Unem.*Min.*Age4	-1.436	-1.511	0.556	-1.288
	(1.876)	(0.923)	(2.183)	(1.150)
Unem.*Trade*Age4	-3.445	-2.098**	-0.060	-0.563
	(2.559)	(1.057)	(0.758)	(0.665)
Unem.*Tran.*Age4	4.010	2.596	1.418	0.181
	(3.959)	(1.735)	(1.967)	(1.400)
Unem.*Agri*Age4	-2.835	13.692***	0.290	-0.242
	(7.044)	(4.477)	(0.764)	(0.447)
Unem.*Sev.*Age4	-0.756*	-0.969***	-1.672	0.319
	(0.426)	(0.345)	(1.483)	(1.003)
Unem.*Pub.*Age3	-0.494	-0.633*	11.902	1.360
	(0.626)	(0.379)	(10.647)	(2.091)
Unem.*Con.*Age3	-1.244	-0.335	7.016	-6.330**
	(2.846)	(1.140)	(5.306)	(2.671)
Unem.*Fin.*Age3	-1.658	-1.073	-5.104	1.970
	(1.184)	(0.742)	(3.726)	(1.323)
Unem.*Man.*Age3	0.352	0.424*	-0.487	-0.248
	(0.599)	(0.218)	(0.759)	(0.257)
Unem.*Min.*Age3	-3.345	-1.868**	1.441	-0.999
	(2.944)	(0.826)	(2.208)	(1.038)

Unem.*Trade*Age3	-2.139	-2.382**	0.566	-0.430
	(2.089)	(0.927)	(0.749)	(0.577)
Unem.*Tran.*Age3	9.651	3.203**	-0.276	-0.673
	(7.315)	(1.527)	(2.085)	(1.214)
Unem.*Agri *Age3	-8.061	12.130***	0.434	-0.274
	(11.219)	(3.647)	(0.688)	(0.395)
Unem.*Sev.*Age3	0.546	-0.368	-0.760	1.441
	(0.662)	(0.316)	(1.578)	(0.923)
Unem.*Pub.*Age2	0.059	-1.178***	2.465	2.263
	(0.497)	(0.398)	(4.618)	(2.254)
Unem.*Con.*Age2	0.395	-2.692**	5.321	-1.432
	(1.592)	(1.198)	(3.878)	(2.532)
Unem.*Fin.*Age2	-0.642	-1.482**	-1.418	1.289
	(0.694)	(0.707)	(2.488)	(1.289)
Unem.*Man.*Age2	0.889*	0.237	-0.139	0.596**
	(0.470)	(0.214)	(0.746)	(0.291)
Unem.*Min.*Age2	-1.756	-1.398*	0.632	0.389
	(1.901)	(0.793)	(1.429)	(1.213)
Unem.*Trade*Age2	-3.010	-1.668*	-0.635	-0.518
	(2.392)	(0.983)	(1.203)	(0.608)
Unem.*Tran.*Age2	5.171	2.589	-1.591	0.054
	(3.836)	(1.624)	(2.098)	(1.293)
Unem.*Agri *Age2	1.524	12.184***	0.784	-1.272***
	(6.979)	(3.529)	(1.527)	(0.407)
Unem.*Sev.*Age2	0.046	0.379	1.059	4.239***
	(0.417)	(0.334)	(1.006)	(0.853)
Unem.*Pub.*Age1	-0.214	-1.407***	9.487	2.040
	(0.494)	(0.441)	(10.459)	(2.506)
Unem.*Con.*Age1	1.195	-3.968***	5.789	-7.376***
	(1.631)	(1.180)	(4.853)	(2.748)
Unem.*Fin.*Age1	-0.880	-2.388***	-3.742	1.628
	(0.723)	(0.777)	(3.714)	(1.525)
Unem.*Man.*Age1	0.713	0.287	-0.160	0.851***
	(0.465)	(0.233)	(0.818)	(0.322)
Unem.*Min.*Age1	-1.318	-1.174	1.037	0.655
	(1.916)	(0.837)	(1.896)	(1.487)
Unem.*Trade*Age1	-2.796	-1.224	0.357	-0.452
	(2.400)	(1.049)	(0.741)	(0.716)
Unem.*Tran.*Age1	4.241	2.025	1.078	2.041
	(3.895)	(1.722)	(1.718)	(1.421)
Unem.*Agri *Age1	4.808	12.730***	-0.702	-2.393***
	(7.042)	(3.917)	(0.621)	(0.473)
Unem.*Sev.*Age1	0.079	0.319	-0.466	4.007***
	(0.432)	(0.347)	(1.464)	(0.958)
F statistics	8.9	26.4	6.7	12.3
N	506,753	506,753	216,113	216,113

Notes: Robust standard errors, calculated assuming that observations are independent across years and states but not within states in a given year, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Both regressions include controls for demographic variables, such as education, age, race/ethnicity, and marital status. For the BRFSS sample, other covariates include *state* *cigarette taxes*, *beer taxes*, state and year fixed effects and for the NHIS sample, other covariates include *MSA cigarette taxes*, *beer taxes*, MSA and year fixed effects. Age1: age group for 25-29; Age2: age group for 30-39; Age3: age group for 40-49; Age4: age group for 50-55.