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Weight and Wages: The Effect of Changing BMI Over Time

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WEIGHT AND WAGES: THE EFFECT OF CHANGING BMI OVER TIME

by

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Abstract

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Obesity in the United States has been growing at an alarming rate, driving up health care costs and also promoting a worsening wage penalty for overweight workers. This study explores the determinants of the wage penalty borne by overweight individuals. To investigate this phenomenon, individual BMI history was obtained from the Panel Study of Income Dynamics for 1986-1999. Upon examination of the cross-sectional data from 1986, there was a wage penalty observed for males who were underweight and for females who were overweight. The analysis of panel data from 1986 and 1999, however, showed that it is not the BMI in 1986 but rather the change in BMI between 1986 and 1999 that is associated with a wage penalty. Among males, a wage penalty exists for those displayed an increase or decrease in BMI from normal weight compared to those who stayed normal weight. Among females, a wage penalty was seen for all who showed an increase in BMI. These results suggest that the overweight/normal weight wage gap is driven in part by a non-causal explanation rather than a causal explanation such as BMI. For example, individuals with increasing BMI may have lower self-esteem, leading to less ambition to climb to higher paying jobs in the work force.

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CHAPTER ONE

INTRODUCTION

A. The Obesity Epidemic

Obesity has become a worldwide epidemic, so large of an issue that the Surgeon General of the United States had to produce a statement on the subject. She stated that from the years of 1980 to 2008, the rate of obesity in adults increased from 13.4% to 34.4% and from 5% to 17% in children (U.S. Department of Health and Human Services, 2010). This means that about a third of adult Americans are obese and at risk of the many negative health conditions associated with obesity. Upon comparison of large nations worldwide over the past 15 years, it can be seen that there is an upward global trend of obesity rate with the United States leading the charge (Bhattacharya and Sood, 2011). The Surgeon General mentioned some of the conditions associated with obesity, such as type 2 diabetes, heart disease, stroke, arthritis, and many forms of cancers, all of which have drastically reduced risk factors among patients in good health (U.S. Department of Health and Human Services, 2010). The occurrence of type 2 diabetes alone tripled since 1980 along with the obesity rate (U.S. Department of Health and Human Services, 2010). In addition, it was estimated that obesity contributes to 112,000 preventable deaths each year (U.S. Department of Health and Human Services, 2010). These preventable deaths and the increase of obesity result in many negative effects on society and the economy as a whole.

B. The Effect of Obesity on Wages

In addition to the growing obesity problem, there is also a growing wage gap between obese workers and non-obese as shown by Baum and Ford (2004) from 1981 to 1998. This increasing epidemic in the United States has become more costly to employer health care than smoking and alcoholism (Baum and Ford, 2004). Obesity has resulted in an overall 41.5% increase in medical spending (Hammond and Levine, 2010). This loss of wages can be viewed over time by negative marginal effects of BMI on a wage curve produced by Han, Norton, and Stearns (2009). In addition to loss of wages it was also found that the obese are penalized by a lesser probability to be employed, except for black women and men (Han, Norton, and Stearns, 2009).

The wage gap experienced by the obese is very evident but the reasons are yet to be truly known. There are a few possible reasons that this gap may exist. Mocan and Tekin (2009) theorized that obesity affected wages through self-esteem and that the gap in wages was due to additional health care costs getting passed down to employees in the form of lost wages (Bhattacharya and Sood, 2009). They showed that BMI had a negative relationship with self-esteem and wages with the most significant results in the obese category. This relationship was only significant in black males and women, however (Mocan and Tekin, 2009). Another study by Bhattacharya and Sood (2009) refuted this evidence by showing that all obese employees are affected by the wage gap, but found the findings to only be significant in jobs that provide their employees with health care. Other factors that could be contributing to the loss of wages are health constraints resulting in more time off fro work and therefore lower productivity, more economic myopicness where the individual values present utility more so will partake in more risky behaviors regardless of future outcomes such as poor eating patterns and less current job training, and also customer discrimination where in jobs requiring interpersonal interactions obese individuals make less (Baum and Ford, 2004).

C. Unobserved Individual Heterogeneity Contributes to Wage Penalty and Relation to Obesity

Similar patterns of lost wages are seen amongst smokers in the work force in that they exhibit lost wages as well as the obese employees. The wage gap between smokers and nonsmokers can be as high as 10% as a result of negative health effects, just as obesity affected wages (Grafova and Stafford, 2009). Grafova and Stafford (2009) examined the relationship between smokers and wage using panel data of persistent smokers, nonsmokers, future quitters, and former smokers. The largest loss in wages was exhibited amongst the persistent smokers, and surprisingly the former smokers exhibited no loss in wages (Grafova and Stafford, 2009). This indicated that there was more to the loss in wages than simply smoking or not, but that there differences between these smokers as a result of a causal variable that can be described as unobserved individual heterogeneity.

This same concept can be applied to obesity in that not every obese worker is the same. Using Panel Study of Income Dynamics (PSID) data of workers' height and weight, BMI can be tracked over the years and a relationship can be found against wages. Employees will be categorized into normal (18.5–24.9 BMI), overweight

(25.0–29.9 BMI), and obese (>30.0 BMI) (CDC, 2015). With BMI as the independent variable and wages as the dependent, it would be expected based off of previous studies that the relationship would be negative. The question to be answered is that if employees' BMIs increased, decreased, or stayed constant in these categories does it have an effect on wages? This is an important question to ask as the Grafova and Stafford (2009) study on smokers provided evidence that perhaps not all smokers experience a loss of wages but instead a certain sub-group of smokers experience the penalty while another does not. This can be relatable to the obese worker population in that not all individuals exhibit the same trends in BMI gain or loss to or from obesity. It is hypothesized that employees who were formerly obese or overweight will show less or no loss wages when compared to the normal BMI employees. However, the group that shows increasing BMI's or constant BMI in the obese and overweight range would be expected to experience loss of wages, if not maybe more as time goes on.

It would also be interesting to see if any employees went from normal to overweight or overweight to obese and if a wage gap was experienced the entire time or if one perhaps developed. This is an important test because if a person with a normal BMI who becomes overweight or overweight to obese experiences the wage loss from the beginning then it could be a sign of the lower wages being a result of unobserved individual heterogeneity. One unobserved causal variable Baum and Ford (2004) proposed was that obese employees experienced lost wages due to their myopic demeanor. This means that they experience a high discount rate so they value the future health much less than they do the present. They found that obese workers had flatter earning profiles compared to the average worker, proposing it was a result of their devaluation of the long-run and therefore do not participate in job training and other methods of providing income growth (Baum and Ford, 2004).

It is important to determine the causes of the wage gap between obese and normal weight employees because over time the gap is getting larger. Currently the wage penalty is about 6.3% for obese employees (Baum and Ford, 2004). The obesity epidemic in the United States is having negative effects on the economy as a whole and in the labor force. Testing the effect of BMI gain, loss, or stagnancy on wages would shed light to another aspect of the causes of such inequality in wages.

D. The Contribution and Organization of This Paper

Using panel data from the 1986 a d 1999 Panel Study of Income Dynamics, this paper investigates the effect of the change of an individuals BMI over time on wages as to provide further insight regarding the causes of the wage penalty overweight individuals bear. Controlling for wage determinants such as education, experience, marital status and health, this paper finds a wage penalty for underweight males and for overweight females compared to the normal weight. In addition, this study also finds evidence of unobserved individual heterogeneity contributing to the penalty that obese employees exhibit, as there are penalties for individuals who gain weight and lose weight for males, but only for females gaining weight and remaining overweight compared to being constantly normal weight.

The organization of this paper is as follows. Chapter Two provides a review of existing literature regarding the causes of the wage penalty for obese workers I addition to a smoking wage study used to determine the presence of unobserved individual heterogeneity amongst smokers' wage penalty. Chapter Three describes the econometric models used in this analysis. Chapter Four provides a description of the data set used to determine the affect of BMI change over time on wages. Chapter Five presents the results of this econometric analysis, and Chapter Six provides conclusions.

CHAPTER TWO

A REVIEW OF THE WAGE PENALTY OBSERVED AMONGST OBESE WORKERS

This chapter provides a review of existing literature concerning the wage penalty observed amongst the obese working population. In particular, this chapter provides a background on the variables associated with the noncausal effects of BMI on wages with an introduction to evidence of the presence of causal variables contributing to the wage penalty.

A. Reasons for the Obese Wage Penalty

There have been many studies determining the variables contributing to the wage gap observed amongst obese workers. It has been estimated that the wage penalty exhibited by the obese population is as high as 6.3% (Baum and Ford, 2004). Baum and Ford (2004) predicted there were four major reasons for the wage penalty. First, that the obese exhibit health constraints resulting in weight related diseases that force time off from work and lower productivity. Second, they are economically myopic, meaning that they do not value future earnings as much as the typical person so they do not see the value in spending high values time now to train for higher future wages, resulting in a flatter earnings profile. Third, they incur higher medical costs for employer provided health care and as a result employers pay less to account for the higher future costs. Lastly, they are discriminated against by customers. It has been demonstrated by Baum and Ford (2004) that a wage gap exists beginning in 1981 and continues to grow as time goes on. Up until 1997 it can be seen that each wage rate is growing but the wage for nonobese is growing at a faster rate than that of the obese wage rate. After 1997, the wage for nonobese continues along its growth pattern while the wage rate for the obese actually diverges and falls (Baum and Ford, 2004).

B. Employee Provided Medical Insurance and Obesity

In regards to the decreased productivity, which occurred as a result of the negative health effects associated with obesity, it was estimated that there was no significant effect on wages when controlling for health limitations (Baum and Ford, 2004). In order to predict the effects of myopicness of the obese on wages, Baum and Ford (2004) proposed that a flatter earnings profile would be exhibited due to the fact that myopic workers value the future less than the typical employee, and so will be less likely to participate in programs such as job training, that would increase their human capital and potentially future wages. This is thought to be a trait of obesity because the obese individuals would value the present more than the future and would indulge in riskier activities with less regard for their future health (Baum and Ford, 2004). It was indeed found that a flatter earnings profile was observed amongst the obese population, even when comparing equally experienced obese versus nonobese employees (Baum and Ford, 2004).

When testing the hypothesis that increased health insurance costs lowered the wages of obese employees, it was found that obese employees with employer provided health insurance actually incur less of a wage penalty than obese employees without it (Baum and Ford, 2004). Baum and Ford (2004) suggest that this may be due to the idea that employers providing such benefits do not discriminate against the obese, or that their model does not estimate what they intend. Their hypothesis that the obese exhibited discrimination by customers was also refuted in that the results they obtained pointed towards the notion that the wage penalty was the same across all occupations regardless of customer interactions (Baum and Ford, 2004).

A more recent study by Bhattacharya and Sood (2011) refuted the idea that employee provided health insurance showed no significant effects on wages of obese employees, and instead claimed that the wage gap is experienced solely by occupations with employer provided health insurance.

This theory is supported by Bhattacharya and Sood (2011), in which they compared historical wages of thin versus obese workers with employer provided health care and without it from 1989 to 2003. The study showed that the gap between the wages of healthy employees and obese employees has been becoming greater while the growth of obese employees' wages exhibit a slower growth than the nonobese. They also found that lifetime costs in health care were largest for those obese at a younger age and decreased as they got older (Bhattacharya and Sood, 2011). This concept makes sense when relating it to human capital in that the future wages of an individual are greatest at the beginning of their career, just as the future medical expenses would be greater if the obesity was developed at a younger age.

C. Gender, Ethnicity, Interpersonal Skills, and the Obese Wage Gap

The general population of obese employees exhibits a wage penalty, but studies have shown that this penalty is not the same across gender and races. Cawley (2004) compared the wages of white, Hispanic, and black males and females in comparison to the nonobese employee and related these findings to the years of education or work experience lost as a result of this penalty. In order to correct for the theory that wages affect BMI, a model was used in which the weight of the individual was lagged by seven years, and the normal time scaled model was also used. The results showed that obese white, black, and Hispanic females in addition to Hispanic males earned less than their nonobese counterparts, whereas the wages of black males actually showed a positive correlation with increasing BMI in all models (Cawley, 2004). The most significant negative effects of obesity on wages were exhibited amongst white females where a 9% penalty was observed, equating to about 1.5 years of education or three years of work experience (Cawley, 2004). These results were supported by Caliendo and Gehrsitz (2014) in which they found that wages peaked for women at a BMI of 21.5 and decreased at higher BMIs, whereas men exhibit a wage penalty at underweight BMIs with wages rising with increasing BMI, but with diminishing marginal returns. One explanation for the deviation of white women from black and Hispanic women in terms of lost wages is that there is a larger impact on the self-esteem on white women and therefore larger negative effects on their occupation and wages (Cawley, 2004).

Mocan and Tekin (2009) estimated the effects of self-esteem as a result of obesity on wages. In support of the Cawley's (2004) study, it was found that self-esteem attributable to obesity has a negative effect on white females but there was no significant data to display an effect amongst black females (Mocan and Tekin, 2009). In addition, it was found that the impact of obesity related self-esteem had less of an effect on the wages of black males and no significant relationship amongst white males (Mocan and Tekin, 2009). This study shows that self-esteem can indirectly affect the wage penalty of obese workers but only by a small amount. As previously mentioned by Baum and Ford (2004), a wage gap may be present for obese workers partially as a result of discrimination by customers, although no significant difference was observed across occupations involving interpersonal skills. Han, Norton, and Stearns (2009) explored this concept by separating the obese and nonobese populations by race, gender, and the type of interpersonal skill that is involved for the relevant occupation, because some jobs require a higher degree of social contact than others. It was observed that in jobs requiring interpersonal skills, a larger wage penalty was present and increased with age, with the most significant effects seen in white and black women with the penalty being as high as 11.9% (Han, Norton, and Stearns, 2009).

Similarly, the obese may exhibit discrimination on the supply side of things. This is examined by Lundborg, Nystedt, and Rooth (2010) in their study on Swedish military enlistees during the time period of 1971 through 1997 in which the overweight population increased from 6% to 13% and the proportion of obese increased from 1% to 4%. Although these numbers are low in comparison to the United States, the growth patterns are similar, so a focused study such as this one may demonstrate some relationship to the same problems occurring in the U.S. and all around the world. Lundborg, Nystedt, and Rooth (2010) examined the effect of cognitive skills, noncognitive skills, and physical fitness on earnings for this sample group. The level of cognitive and noncognitive skills were determined by tests taken upon enlisting for the military. In order to determine the impact of these supply-side variables to account for discrimination, each of the three variables were controlled for with respect to the relationship between BMI and earnings, resulting in about four fifths of the earnings gap estimated to be caused by these discriminatory variables (Lungborg et al., 2010).

D. Causal Variables for the Correlation Between BMI and the Obese Wage Gap

As demonstrated, there are many variables that affect the wage gap observed amongst the obese population in the work force. Perhaps there is a correlation between the changes in an individual's BMI over time, potentially revealing unobserved causal variables, which affect the wage penalty through a correlation of BMI and wages such as myopia. It is possible that someone who is obese may observe less of a wage gap or maybe even no wage gap if their BMI is decreasing or they were formerly obese, however, someone who is obese and exhibits a still increasing BMI may observe a high wage penalty. Grafova and Stafford (2009) conducted a similar study amongst smokers because they too exhibit a wage penalty, possibly as high as 10% compared to nonsmokers. The sample populations were separated into the categories of persistent smokers, nonsmokers, occasional smokers, and former smokers and the effects of each category's earnings were estimated (Grafova and Stafford, 2009). It was found that the largest penalty was observed amongst the persistent smokers, less of a penalty amongst the occasional smokers, although not significant, and no penalty amongst the former smokers in comparison to nonsmokers (Grafova and Stafford, 2009). This study revealed evidence that there is unobserved individual heterogeneity amongst the smokers accounting for a portion of the wage penalty.

Conducting a similar study in which the sample populations are currently obese, formerly obese, formerly normal weight, and currently normal weight in terms of decreasing, increasing or constant BMI over a set number of years in relation to wages can estimate the effects of each trait on the wage penalty. Similar to Grafova and Stafford (2009), this would provide evidence of the presence of unobserved individual heterogeneity amongst the obese workers. The fact that these workers became obese at one time or another during their careers but show different wage penalties shows that although categorized as an obese employee, they are actually different. These differences can be accounted for by causal variables that are not observable. Perhaps obese employees do not all receive the observed wage penalty but only a specific population of obese employees. It is hypothesized that in comparison to normal weight employees there will be no wage penalty observed amongst the formerly obese and a penalty comparable to that of previously predicted wage gaps for obese workers amongst the currently obese and formerly normal weight employees.

CHAPTER THREE

ESTIMATING THE WAGE PENALTY FROM UNOBSERVED INDIVIDUAL HETEROGENEITY AMONG OBESE WORKERS

This chapter describes the econometric models used in this analysis and discusses each of the dependent and independent variables.

A. Econometric Model to Estimate the Effect of BMI on Wages

To examine the effect of an employee's BMI class on wages, this study uses the following econometric model:

$$(1) \quad \log WAGE_i = \beta X_i + \gamma_0 BMI\_CLASS_i + e_i$$

where e_i is the stochastic disturbance term.

B. Econometric Model to Estimate the Effect of BMI on Wages Controlling for Health

To examine the effect of an employee's BMI class on wages while controlling for the health status of the individual, this study uses the following econometric model:

$$(2) \quad \log WAGE_i = \beta X_i + \gamma_0 BMI\_CLASS_i + \gamma_1 HEALTH_i + e_i$$

where e_i is the stochastic disturbance term.

C. Econometric Model to Estimate the Effect of Unobserved Individual Heterogeneity

To examine the effect of an employee's change of BMI on wages as a means of showing unobserved individual heterogeneity, this study uses the following econometric model:

$$(3)\quad \log WAGE_i = \beta X_i + \gamma_0 BMI\_CHANGE_i + e_i$$

where e_i is the stochastic disturbance term.

In order to account control for the health status of the individual, the following econometric model is used:

$$(3')\quad \log WAGE_i = \beta X_i + \gamma_0 BMI\_CHANGE_i + \gamma_1 HEALTH_i + e_i$$

where e_i is the stochastic disturbance term.

Dependent Variable

log *WAGE*	The log of the hourly wage rate for the individual in year 2000 dollars

Independent Variables

BMI_CLASS (Reference group: Normal BMI individuals: BMI less than 25)

UNDERWEIGHT	1 if the individual's BMI is greater than 1 and less than 18.5; 0 otherwise
OVERWEIGHT	1 if the individual's BMI is greater than 25; 0 otherwise

BMI_CHANGE (Reference group: Normal BMI and maintenance within BMI; BMI classes refer to the ranges as described above)

CONST_UND	1 if the individual stays in underweight BMI range; 0 otherwise
UND_NORM	1 if the individual goes from underweight BMI range to normal BMI range; 0 otherwise
UND_OVER	1 if the individual goes from underweight BMI range to overweight BMI range; 0 otherwise
NORM_UND	1 if the individual goes from normal BMI range to underweight BMI range; 0 otherwise
NORM_OVER	1 if the individual goes from normal BMI range to overweight BMI range; 0 otherwise
CONST_OVER	1 if the individual stays in overweight BMI range; 0 otherwise
OVER_NORM	1 if the individual goes from overweight BMI range to normal BMI range; 0 otherwise
OVER_UND	1 if the individual goes from overweight BMI range to underweight BMI range; 0 otherwise

HEALTH (Reference group: Good health as reported by individual)

FAIR_POOR	1 if the individual reported that he/she has self-perceived fair or poor health; 0 otherwise
VERY_GOOD	1 if the individual reported that he/she has self-perceived

	very good health; 0 otherwise
EXCELLENT	1 if the individual reported that he/she has self-perceived excellent health; 0 otherwise

The following independent variables refer to X_i in equations (1), (2), and (3):

<u>Education</u> (Reference group: Less than high school completed)	
HIGHSCHOOL	1 if the individual has completed high school; 0 otherwise
SOME_COLLEGE	1 if the individual has completed some college; 0 otherwise
COLLEGE	1 if the individual has completed college; 0 otherwise
POST_GRAD	1 if the individual has completed some post graduate education; 0 otherwise
<u>Work Status</u>	
TENURE	The number of years the individual has been at his/her job
TENURE_SQ	The number of years squared the individual has been at his/her job
EXPERIENCE	The number of years that the individual has been working for money since age 18
EXPERIENCE_SQ	The number of years squared that the individual has been working for money since age 18
WHITE_COLLAR	1 if the individual works in a white collar field; 0 otherwise
UNION	1 if the individual belongs to a union; 0 otherwise
<u>Lifestyle</u>	
MARRIED	1 if the individual is married; 0 otherwise
<u>Race</u> (Reference group: White individuals)	
NONWHITE	1 if the individual is not white; 0 otherwise
<u>Age</u>	
AGE	The individual's age
AGE_SQ	The individual's age squared

The single dependent variable used in this study is log *WAGE* used as a comparative measure for wages between the defined working populations. There are three key dependent variables being estimated in this study: *BMI_CLASS, HEALTH,* and *BMI_CHANGE.* The models used in this study require the use of BMI to be calculated for each worker. BMI will be calculated by the following equation:

$$BMI_i = \frac{(WEIGHT * 0.45)}{(HEIGHT * 0.025)^2}$$

where WEIGHT is in pounds and HEIGHT is in inches (CDC, 2005). The data for height and weight in addition to other individual characteristics will be obtained from the Panel Study of Income Dynamics (PSID) over two waves, 1986 to 1999.

The first key independent variable, *BMI_CLASS*, groups individuals into weight classifications of *UNDERWEIGHT*, *NORMAL*, and *OVERWEIGHT*. The classification for underweight BMI is less that 18.5, normal BMI is between 18.5 and 20, overweight BMI is between 20 and 25, and obese BMI is greater than 30 (CDC, 2015). The BMI classes of overweight and obese will be grouped into one variable referred to as *OVERWEIGHT*. These variable will be used to establish the wage differences between the BMI classes and therefore establishing that a wage penalty exists amongst the data acquired for the obese population, and potentially even the overweight population. It is predicted based off of previous literature that a wage penalty would be observed amongst the OVERWEIGHT and UNDERWEIGHT populations (Cawley, 2004).

The second key independent variable is *HEALTH,* which is used to control for the health of an individual in addition to the model (1) variables resulting in the formation of model (2). Model (2)'s purpose is to provide evidence that the wage gap is occurring in the independent of the individual's health status. Including the *HEALTH* variable that indicates whether the individual self-reported having fair, poor, good, very good, or excellent health controls for this scenario. The health status for fair and poor are grouped into a single variable referred to as FAIR_POOR. It is predicted that as EXCELLENT and VERY_GOOD health will have positive effects on wages compared to GOOD, while FAIR_POOR will show negative effects.

Model (3) incorporates the third key independent variable, *BMI_CHANGE.* This variable serves to estimate the effects of different groups of the obese population on wages. They are separated into groups based upon whether or not over the waves in which the study is examining that employees who were formerly overweight (*OVER_NORM* and *OVER_UND),* formerly normal weight (*NORM_OVER* and *NORMAL_UND)*, formerly underweight *(UND_NORM* and *UND_OVER),* or maintained a constant BMI other than normal weight (*OVER_OVER* and *UND_UND)* has an impact on wages compared to someone who has remained normal weight *(NORM_NORM)* over the defined time spans. Because the individuals being studied were overweight at some point in their employment history they would be expected to exhibit a wage penalty as determined by previous studies however because their BMI's change in different ways they need to be grouped into separate populations. It could be predicted that individuals of the *NORM_OVER* category would experience a wage penalty even though they are normal weight at the time of the wage assignment because they are showing an increase in BMI over time due to some factor related to work productivity. Yet an individual in the *OVER_NORM* category would not exhibit the wage penalty typically associated with overweight employees as they display a decreasing BMI, refuting the cross sectional analysis that an overweight individual will have a wage penalty. Separating these populations as described by the *BMI_CHANGE* variables allows for unobserved individual heterogeneity to be seen as having an effect in wages compared to the constant normal weight group. Using model (3') will provide a control for the individuals' health status.

The X_i terms will be used to include individual characteristics of the subjects serving as a control for noncausal wage determining variables. It is expected that as one's education increases then so do their wages. In addition, it is predicted that for each additional year of experience and each additional year that someone works at their current job that their wage will increase providing the variables TENURE and EXPERIENCE with positive coefficients. Positive coefficients are also expected for WHITE_COLLAR, UNION, and AGE but a negative coefficient for the variable NONWHITE. As for the variable MARRIED, that is expected to show a positive coefficient as married individuals usually make more money than non-married individuals.

D. Estimation Methods

This paper estimates each of the econometric models using ordinary least squares (OLS). Following similar parameters to Grafova and Stafford (2009), individuals outside of the age range of 25 to 60 were omitted from the regression. Only full-time employees are used in this study by omitting those who have worked less than 1,500 hours in the years being examined. Each regression was run exactly the same for both males and females.

CHAPTER FOUR

SELECTING THE SAMPLE FROM THE PANEL SURVEY OF INCOME DYNAMICS

This chapter provides a description of the Panel Survey of Income Dynamics. It also presents the descriptive statistics for the data set used in this analysis.

A. Overview Panel Survey of Income Dynamics

This study uses panel data from the Panel Survey of Income Dynamics to investigate the effects of BMI change on wages. The PSID is a nationally representative sample directed by the faculty at the University of Michigan. It is used in this study in order to gain a broad data set in terms of the age of the populations examined, as this data set includes individual statistics continuously accumulated over 60 years of surveying over 18,000 individuals from 5,000 families for hundreds of variables. Using the PSID allows for the accumulation of height, weight, and other health related variables while also including family statistics and other wage determining variables.

B. Selection of the Sample and Descriptive Statistics

The full sample of this paper includes 3,075 observations. This sample size was obtained by omitting individuals who worked less than 1500 hours per year or were outsides the ages of 25 to 60 years old. These parameters were used in an attempt to replicate those used by Grafova and Stafford (2009). The sample selected for the years of 1986 and 1999 in order to provide a long enough time span for individuals to fluctuate BMI significantly.

Table 1 shows the descriptive statistics for the full sample separated by males, which had 1,681 observations, and females, which had 1,394. The only variables containing 1999 data was the height and weight data used to calculate BMI in year 1999 for the BMI Change variables, the rest of the variables were representative of the year 1986. Compared to males, who maintained 58% for their population as overweight, only 31% of females were overweight, with majority in the normal weight category at 65%. There was no male who maintained a BMI of constant underweight from 1986 to 1999 so there is no observation for that variable. For females, no BMI change of overweight to underweight was observed for the years 1986 to 1999 either. In males, majority of the sample maintained a constant overweight BMI where as in females the largest BMI change category was constant normal weight. As for self-perceived health status the most popular category for both genders was very good. Curiously, more men evaluated themselves as excellent health, and more women evaluated themselves as fair and poor health.

CHAPTER FIVE

ESTIMATION RESULTS: QUANTIFYING THE EFFECT OF BMI CHANGE ON WAGES

This chapter presents the results of regression analysis. It is divided into six sections. The first section discussed the effect of BMI class on wages for males. The second section discusses the effects of BMI class on wages while accounting for health status for males. The third section discusses the effects of BMI change on wages over the years of 1986 to 1999 for males. The last three sections follow suit of the first three but discuss the effects on female employees instead of males.

A. The Effect of BMI on Wage for Males

Model (1) was used to estimate the effects of an employee's BMI class on wages for males. Table 2 column 1 displays the marginal effects of BMI classes underweight and overweight with normal weight as the reference variable on the log of wages using OLS regressions holding other wage determinants previously mentioned constant. The use of this regression was to establish the effect of BMI on wages and the possible presence of a penalty for each category.

This model estimated that for males there is no significant wage gap for overweight employees, however, it was estimated that on average underweight males do however show a significant penalty of 27%. Other wage determinants such as education behaved as expected it the regression in that as education level increased, relative to some high school completed, the positive effect on wages also increased. In addition, it was found that married workers, on average, make more than non-married workers. It was also found that the each additional year that an individual works at their job, the higher their average wage will be. Furthermore, if an employee is employed in a white-collar job then they will on average, earn more than an individual in a different field. The regression also showed that on average nonwhite employees will make less than white employees. There were no significant effects seen for experience or age on wages, however.

These findings that males observe a wage gap only for the underweight category are consistent for those found by Caliendo and Gehrsitz (2014) where they too found a penalty for underweight males but then increasing wages as BMI increased.

B. Effect of BMI on Wage Controlling for Health for Males

Model (2) takes into account the self-reported health status of the worker using the same independent variables used in model (1). Table 2 column 2 displays the results of the OLS analysis of model (2) where the marginal effects on wage can be exhibited for males. Accounting for self-reported health, it was estimated that underweight BMI had significant a negative effect on wages, similar to that previously displayed in model (1). Underweight male employees were seen to, on average, exhibit a 20% wage penalty in this regression.

As for the controlling variables, they behaved in the same way as the previous model (1). In addition, it was seen that individuals who reported a sub-par health status exhibited significant loss of wages of on average 11% compared to good health employees and the excellent health individuals were seen to have significant positive effects of 7% on wages. This model further supports the claims by Caliendo and Gehrsitz (2014) that underweight males observe a wage penalty.

C. The Effect of BMI Change on Wage for Males

Model (3) estimates the marginal effects of BMI changes on wages by using the change in an individual's BMI with respect to constant normal weight individuals over the time wave of 1986 to 1999 using control variables and the log of wages in the year 1986. This shows that at the time the individual is the first BMI class described in 1986 but then in year 1999 is the next BMI class described. Table 2 column 3 displays the results of the OLS regression for males using model (3) and Table 2 column 4 displays the same OLS regression while taking into account the self-reported health of the individual as previously done in model (2).

For males, it was estimated that on average, individuals whose BMI increased from underweight to normal weight on average exhibited a wage penalty of 28%, but when health is taken into account, this variable becomes insignificant. Individuals who went from underweight to overweight exhibited on average a wage penalty of 14%, and those who went from normal weight to overweight exhibited surprising positive effects of 9% on average. Accounting for health, the penalty for underweight to overweight individuals increased to 15%, where the positive effects for the increasing BMI from normal weight to overweight remained 9%, but became more significant. Individuals who change from normal weight in 1986 to underweight in 1999 and those who change from overweight to underweight display an estimated wage penalty of on average about 52% and 32%, respectively.

When taking into account the self-reported health of the individual, the effect of these two variables on wages still hold true showing a penalty of 44% for normal to underweight individuals and 33% penalty for overweight to underweight individuals. Taking into account health, the same trends were observed without health, except for that the penalty borne by individuals who went from underweight to normal weight became insignificant. The only significant health variable in this regression was for individuals with excellent health in which they exhibited a positive impact on wages of 8%. All other wage determinants behaved in the same trends as previously described.

The results obtained by the OLS regression of model (3) provide evidence that unobserved individual heterogeneity is the cause of wage penalty associated with BMI because at the time in which wages are examined in 1986, males who are normal weight and overweight, taking into account health are estimated no significant wage penalty by model (2), but the normal weight individuals who lose weight to the underweight category and the overweight individuals who lose weight to the underweight category do exhibit a loss of wages (Table 2). The fact that there is no penalty observed at the time of wage observation but there is when accounting for a future change explains that there is another factor at work, which can be described as an unobserved individual heterogeneity.

D. The Effect of BMI on Wage for Females

Model (1) was also used to estimate the effects of an employee's BMI class on wages for female workers. Table 3 column 1 displays the marginal effects of BMI on wages using the same regression variables and limitation mentioned in section A of this chapter. It was estimated that for females, on average, a BMI in the overweight range provides penalization to wages of about 7%, but no significance for the underweight class. These results are supported by Cawley (2004) who found that wage penalties are observed amongst females that worsened the further their BMI got into the overweight category to where they received about a 9% wage penalty, comparable to the estimated results by model (1). The other wage determining variables behaved similarly to the trends observed in model (1) for males but a slightly significant wage penalty was observed for married females. In addition, experience was positively and significantly impacting wages, whereas white collar was insignificant. Once again, age had no significant effects on wages.

E. Effect of BMI on Wage Controlling for Health for Females

Using model (2), the effect of BMI class controlling health was estimates for females. Table 3 column 2 display the results of the OLS analysis of model (2) where the marginal effects on wage can be observed for females. Using model (2) to estimate the marginal effects of BMI on wages, the regression held true to the results of the previous model (1) in which overweight females bore, on average, a wage penalty of 7%. It is also important to note that the self-reported health status of the individual shows no significant effect on wages for females in this regression. All other controlled for variables behaved the same as for model (1) for females.

F. The Effect of BMI Change on Wage for Females

As done in section C of this chapter, model (3) was used to estimate the marginal effects of BMI change on wages from 1986 to 1999 with constant normal weight individuals as the reference variable. This shows that at the time the individual is the first BMI class described in 1986 but then in year 1999 is the next BMI class described. Table 3 column 3 displays the results of the OLS regression for females using model (3) and Table 3 column 4 display the same OLS regression while taking into account health.

As seen in Table 3 columns 3 and 4, estimating the effects of the change in BMI of females on wage gave somewhat similar results to those of the males. For both health unaccounted and accounted for, significant results were observed for individuals going from underweight to overweight and constant overweight from 1986 to 1999, with wage penalties of 69% and 9%, respectively. Including the self-reported health variables, it was estimated that on average, individuals who went from underweight to overweight and constant overweight exhibit the same penalty as without health unaccounted for. Model (3) estimates that for females the only changes in BMI that significantly affect wage are when the individual shows an increase in BMI from underweight to overweight and maintaining an overweight BMI.

The results provide further evidence that unobserved individual heterogeneity is the cause of wage penalty associated with BMI because it was predicted by model (2) that only overweight females should exhibit a wage penalty, but when taking into account the change in BMI by the use of model (3), a female who is currently underweight but will gain weight to the overweight category will in fact have a large wage penalty (Table 3). Another wage penalty is observed amongst females who maintain their overweight BMI (Table 3). This could be due to the wage penalty observed amongst overweight females as shown in model (2), but the penalty here is larger by 2% when accounting for weight gain than for the stagnant, cross sectional BMI, providing further evidence that there is a larger effect from the change in BMI rather than the current BMI of the employee. One possible factor at work for these women is the issue of self-esteem, as supported by the study done by Mocan and Tekin (2009) in which taking into account the individual's self esteem, women in the higher BMI range had lower self esteem and a higher wage penalty, whereas self esteem had no effect on the wage of males.

Although previous literature in regards to BMIs effect on wage has found significant results by measuring the effects of certain factors such as interpersonal skills, as shown by Han, Norton, and Stearns (2009), and management discrimination, as shown by Lundborg, Nystedt, and Rooth (2010), but it is important to also consider the unobserved individual heterogeneity of each employee in the BMI classes. Grafova and Stafford (2009) provided evidence that there are differences amongst the individuals in the broad category of "smokers". There are persistent smokers, future quitting smokers, on and off smokers, yet all three at the same time with a cigarette in hand will be considered smokers. Grafova and Stafford (2009) showed that the wage gap does not exist purely because an individual smokes but because of the unobserved differences between these classes of smokers. What model (3) shows it the evidence that a similar theory can be applied to overweight and obese workers, that there is indeed evidence that BMI alone is not the main contributor to the wage penalty, but also individual unobserved heterogeneity.

CHAPTER SIX

CONCLUSIONS

A. Summary of the Findings

Using the panel data from the 1986 and 1999 PSID, this study attempts to provide evidence of unobserved individual heterogeneity affecting the wages of employees by examining a change in BMI over the given years. This study differs from previous in the sense that the effects BMI change over time is being estimated against wage for as opposed to the traditional cross sectional BMI. Further adaptions of this study include the individuals' health to determine the

This study finds the presence of a wage penalty for underweight males with and without controlling for health status, similar to previous literature findings. Upon estimation of the effect BMI change on wages controlling for health, it was found that males who went from underweight to overweight, normal weight to underweight, and overweight to underweight exhibited a wage penalty compared to constant normal weight males, whereas individuals who went from normal weight to overweight displayed a positive effect on wage. For females, wage penalties were seen amongst both underweight and overweight individuals compared to normal weight females. Similar to males, a wage penalty was observed among the underweight to overweight category females compared to constant normal weight, but females also exhibit a penalty amongst those who maintain an overweight BMI over the indicated years.

Although the regressions taking into account only the current, cross sectional BMI showed that there is no significant wage penalty for males who are normal weight or overweight, there were significant wage penalties for the individuals who were these BMIs in 1986 and then underwent the previously described changes. The same can be said for females who were underweight in that no penalty existed accounting for only the current BMI, but when increasing to overweight a penalty was observed, and when maintaining an overweight BMI a greater negative effect was observed than just the current overweight female statistic. Due to these changes, it is likely that there are variables that cannot be accounted for such as psychological differences or work ethic factoring into the wage penalty observed amongst a portion of the overweight population, that can be described as unobserved individual heterogeneity.

B. Suggestions for Future Research

One limitation of this study is due to the lack of access to residential data of the individuals surveyed by the PSID, future research should include the metropolitan status of the individual data along with state-by-state data. Another limitation of this study is the broad race category "nonwhite". Breaking the regressions down into classes such as Hispanic-white, Hispanic-black, Asian, etc. would be another possible route as shown by Cawley (2004) that different races show different results of the wage penalty of overweight employees. The use of only one time wave is a further limitation of this study. Further work could take into account different waves, such as years 2001 to 2015 to provide supporting data for the single wave examined in this study. Expanding data sets and controlling for more wage determining variables will allow for more accurate estimations of the effect unobserved individual heterogeneity has on the wage penalty for obese employees.

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Table 1: Descriptive Statistics for Males and Females Including All Model Variables

Variables	Male	Female
BMI Class		
Underweight	0.003	0.03
	(0.054)	(0.18)
Normal Weight	0.41	0.65
	(0.49)	(0.48)
Overweight	0.58	0.31
	(0.49)	(0.46)
BMI Change		
Constant Underweight	-	0.009
		(0.092)
Underweight to Normal Weight	0.002	0.02
	(0.042)	(0.15)
Underweight to Overweight	0.001	0.002
	(0.034)	(0.046)
Constant Normal Weight	0.21	0.39
	(0.40)	(0.49)
Normal Weight to Underweight	0.001	0.007
	(0.024)	(0.084)
Normal Weight to Overweight	0.21	0.26
	(0.41)	(0.44)
Constant Overweight	0.54	0.28
	(0.50)	(0.45)
Overweight to Normal Weight	0.05	0.03
	(0.21)	(0.16)
Overweight to Underweight	0.001	-
	(0.024)	
Self-Perceived Health Status		
Fair and Poor	0.06	0.08
	(0.25)	(0.28)
Good	0.22	0.31
	(0.41)	(0.46)
Very Good	0.38	0.36
	(0.49)	(0.48)
Excellent	0.34	0.25
	(0.47)	(0.43)
Other Wage Determinants		
Education		
Less than high school	0.11	0.10
	(0.32)	(0.29)
High school graduate	0.35	0.41
	(0.48)	(0.49)
Some college	0.21	0.25
	(0.42)	(0.43)
College	0.18	0.15
	(0.38)	(0.36)
Graduate School	0.13	0.10
	(0.34)	(0.29)
Married	0.86	0.76
	(0.35)	(0.43)
Tenure (years)	7.9	5.5
	(8.3)	(6.2)
Experience (years)	18.3	13.3
	(9.3)	(7.8)
White Collar	0.52	0.43
	(0.50)	(0.50)
Union member	0.19	0.11
	(0.39)	(0.31)
Nonwhite	0.20	0.27
	(0.40)	(0.45)
Age (years)	37.7	36.8
	(9.3)	(9.1)
Number of Observations	1,681	1,394

Note: The reported values are the means. The standard errors are in parentheses. The means are weighted according to the final annual weights provided by the PSID.

Table 2: Estimates for BMI Class, BMI Class Controlling for Health, BMI Change, and BMI Change Controlling for Health for Males

	Dependent Variable log of wage (year 2000 dollars)			
Independent Variables	Model (1) OLS	Model (2) OLS	Model (3) OLS	Model (3') OLS
BMI Class				
Underweight	-0.309***	-0.226**		
	(0.113)	(0.115)		
Overweight	-0.021	-0.016		
	(0.029)	(0.030)		
BMI Change				
Constant Underweight			-	-
Underweight to Normal			-0.322**	-0.204
			(0.137)	(0.157)
Underweight to Overweight			-0.153*	-0.167**
			(0.082)	(0.083)
Normal Weight to Overweight			0.082*	0.086**
			(0.044)	(0.044)
Normal Weight to Underweight			-0.726***	-0.577***
			(0.045)	(0.076)
Constant Overweight			0.021	0.029
			(0.036)	(0.036)
Overweight to Underweight			-0.380***	-0.400***
			(0.061)	(0.066)
Overweight to Normal Weight			-0.015	-0.013
			(0.085)	(0.085)
Self-Perceived Health Status				
Sub-par		-0.114*		-0.105
		(0.069)		(0.070)
Very Good		0.041		0.043
		(0.038)		(0.037)
Excellent		0.070*		0.074*
		(0.042)		(0.042)
Other Wage Determinants				
Education				
High school graduate	0.181***	0.159***	0.180***	0.159***
	(0.050)	(0.050)	(0.050)	(0.050)
Some college	0.305***	0.279***	0.299***	0.273***
	(0.053)	(0.053)	(0.053)	(0.053)
College	0.578***	0.543***	0.577***	0.541***
	(0.057)	(0.059)	(0.057)	(0.059)
Graduate school	0.646***	0.609***	0.642***	0.605***
	(0.062)	(0.064)	(0.063)	(0.064)
Married	0.114**	0.108**	0.108**	0.101**
	(0.047)	(0.047)	(0.047)	(0.048)
Tenure	0.035***	0.035***	0.035***	0.035***
	(0.005)	(0.005)	(0.005)	(0.005)
Tenure squared	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Experience	0.003	0.004	0.004	0.004
	(0.017)	(0.017)	(0.017)	(0.017)
Experience squared	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
White Collar	0.150***	0.149***	0.150***	0.149***
	(0.031)	(0.031)	(0.031)	(0.031)
Union member	0.154***	0.154***	0.153***	0.153***
	(0.029)	(0.029)	(0.029)	(0.029)
Nonwhite	-0.166***	-0.147***	-0.167***	-0.148***
	(0.041)	(0.040)	(0.041)	(0.040)
Age	0.033	0.033	0.033	0.033
	(0.034)	(0.034)	(0.034)	(0.034)
Age squared	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)

Constant	1.215**	1.202**	1.178**	1.153**
	(0.513)	(0.515)	(0.516)	(0.518)
Observations	1,681	1,681	1,681	1,681
R-squared	0.278	0.282	0.280	0.285

Note: The standard errors are presented in parentheses. The values in the table represent coefficients for each dependent variable. All regressions are weighted according to the final annual weights provided by the PSID.

*Statistically significant at the 0.10 level.

**Statistically significant at the 0.05 level.

***Statistically significant at the 0.01 level.

Table 3: Estimates for BMI Class, BMI Class Controlling for Health, BMI Change, and BMI Change Controlling for Health for Females

	Dependent Variable log of wage (year 2000 dollars)			
Independent Variables	Model (1) OLS	Model (2) OLS	Model (3) OLS	Model (3') OLS
BMI Class				
Underweight	-0.056	-0.058		
	(0.074)	(0.074)		
Overweight	-0.077*	-0.071*		
	(0.040)	(0.040)		
BMI Change				
Constant Underweight			-0.046	-0.039
			(0.101)	(0.101)
Underweight to Normal Weight			0.010	0.004
			(0.080)	(0.080)
Underweight to Overweight			-1.183***	-1.178***
			(0.391)	(0.381)
Normal Weight to Underweight			0.142	0.145
			(0.153)	(0.150)
Normal Weight to Overweight			-0.018	-0.014
			(0.045)	(0.045)
Constant Overweight			-0.097**	-0.092**
			(0.046)	(0.045)
Overweight to Underweight			-	-
Overweight to Normal Weight			0.083	0.095
			(0.092)	(0.094)
Self-Perceived Health Status				
Sub-par		-0.049		-0.063
		(0.069)		(0.070)
Very Good		-0.027		-0.031
		(0.042)		(0.042)
Excellent		0.026		0.016
		(0.050)		(0.050)
Other Wage Determinants				
Education				
High school graduate	0.277***	0.272***	0.285***	0.279***
	(0.062)	(0.061)	(0.062)	(0.062)
Some college	0.443***	0.434***	0.448***	0.439***
	(0.068)	(0.068)	(0.067)	(0.067)
College	0.715***	0.705***	0.718***	0.707***
	(0.070)	(0.069)	(0.070)	(0.070)
Graduate school	0.797***	0.783***	0.798***	0.785***
	(0.081)	(0.083)	(0.082)	(0.083)
Married	-0.074*	-0.067*	-0.073*	-0.066*
	(0.039)	(0.039)	(0.039)	(0.039)
Tenure	0.066***	0.066***	0.066***	0.065***
	(0.008)	(0.008)	(0.008)	(0.008)
Tenure squared	-0.002***	-0.002***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Experience	0.035***	0.035***	0.036***	0.036***
	(0.011)	(0.011)	(0.011)	(0.011)
Experience squared	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
White Collar	0.049	0.047	0.048	0.046
	(0.037)	(0.037)	(0.037)	(0.037)
Union member	0.232***	0.230***	0.228***	0.226***
	(0.039)	(0.039)	(0.039)	(0.039)
Nonwhite	-0.166***	-0.162***	-0.159***	-0.157***
	(0.050)	(0.050)	(0.050)	(0.051)
Age	-0.009	-0.009	-0.009	-0.009
	(0.019)	(0.019)	(0.019)	(0.019)
Age squared	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)

Constant	1.808***	1.814***	1.795***	1.803***
	(0.333)	(0.337)	(0.334)	(0.338)
Observations	1,394	1,394	1,394	1,394
R-squared	0.316	0.317	0.323	0.324

Note: The standard errors are presented in parentheses. The values in the table represent coefficients for each dependent variable. All regressions are weighted according to the final annual weights provided by the PSID.

*Statistically significant at the 0.10 level.

**Statistically significant at the 0.05 level.

***Statistically significant at the 0.01 level.