ARE OBESE PEOPLE CHOOSING MORE SEDENTARY JOBS?

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ABSTRACT

Throughout the developed world there are a growing number of people becoming obese. Advancing technology continues to make our jobs less physically demanding. I show that a person with a higher body mass index (BMI) does not choose a more sedentary job position.

Job strenuousness is found by using principal component analysis. The three instrumental variables used for two-stage least squares are youth health, the number of restaurants per state per thousand residents, and an indicator variable if a person plays computer games at home. I reviewed 2SLS, JN2SLS and ordinary least squares (OLS) regressions and based on the testing results, I choose to use the efficient, consistent, and unbiased estimates of OLS.

Taking into account the bias on BMI, the OLS results show the coefficient on BMI is not statistically significantly different from zero.

DEDICATION

I dedicate this work to my husband, Phillip. Without his support, I would not have come this far. And to Harley and Violet, without their smiling faces to come home to every night I would have never made it through.

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INTRODUCTION

Throughout the developed world there are a growing number of people becoming obese. In the United States this problem has grown to epidemic proportions. The latest data from the National Center for Health Statistics show that thirty percent of U.S. adults over twenty years of age are obese (CDC 2006). Americans have continued to 'expand' in terms of average body mass index (BMI) since the 1960's. To put these statistics in perspective, in 1995 all fifty states in the U.S. had a statewide average BMI less than 19. Nine years later (2004) thirty-three states had an average population BMI of 20 - 24 and nine additional states had an average BMI greater than 25.

Advancing technology continues to make our jobs less physically demanding. There is an association between less strenuous jobs and obesity. Phillipson and Lakdawalla (2002) discuss this correlation between weight and an increase in sedentary home- and market-production. What has yet to be shown is the causal relationship between the outcomes of increased BMI and decreased physical activity in market production. In this paper, I intend to show whether a person with a higher BMI chooses a more sedentary job position.

With obesity at an all time high, there has been an increase of research on the topic. Currently, obesity is the second leading killer in the United States (behind smoking) of ailments created by choice (CDC 2006). There are many factors to consider when determining why a person may become obese. Current research examines several possible contributors to obesity.

A plethora of research links obesity to job status. People who work fewer hours or are unemployed may be more likely to become obese. Paraponaris, Saliba, and Ventelou (2005) find that obesity could be a contributor to unemployment. Three other studies (Zagorsky 2005, Cawley 2004, and Cawley 2005) find similar results. Other environmental factors such as urbanization and education have also been shown to contribute to obesity in the U.S.

Additionally, researchers look toward sedentary lifestyles as a major contributor to obesity. Philipson and Lakdawalla (2002) state that technological change, by making household and market work more sedentary, has raised the cost of physical activity. Philipson and Lakdawalla (2002) also find that by making agricultural production more efficient, the cost of calories has decreased.

Using the National Longitudinal Survey of Youth (NLSY), Philipson and Lakdawalla (2002) isolate the effects of job-related exercise on weight. They isolate these effects by investigating whether heavier, more sedentary people sort themselves into sedentary jobs, examining the effect that weight accumulates over time, finding a reliable measure of job-related exercise, and controlling for self-reporting height and weight measurement error. Philipson and Lakdawalla (2002) find the long-run effects on weight by occupational choice are almost four times as large as the one year effects. If heavier people pre-sorted themselves into more sedentary jobs, the long term effects would be equal to the one year effects. Philipson and Lakdawalla (2002) also find four more conclusions that support the result that sedentary, heavier people do not pre-sort themselves into more sedentary jobs. First, the change of people switching into more sedentary jobs is not preceded by increases in BMI. Second, people switching to less strenuous jobs are not heavier on average then the average person surveyed. The last two effects found by Philipson and Lakdawalla (2002) suggest that human capital changes create occupational switching. People that switch to less strenuous occupations, their education level correspondingly increases. Finally, a respondent that switches to a less strenuous job reduces their number of hours worked per week by significantly less then a respondent that does not switch occupations.

Philipson and Lakdawalla (2002) find by observing occupational switching over time, occupation is exogenous with respect to weight. They conclude that sixty percent of the recent growth in average weight may be caused by declining physical activity from technological changes in home and market production.

My research confirms Philipson and Lakdawalla’s (2002) conclusions that heavier people do not sort themselves into more sedentary jobs. I use newer measures of job strenuousness and a different survey, the Panel Study of Income Dynamics (PSID), to show this casual relationship. The relationship of my theoretical results and the literature is further discussed in the data section. In the remainder of the paper, I discuss the theory behind my model, the source of the data used, my analysis, and my overall findings.

THEORETICAL AND EMPIRICAL MODELS

The relationship between BMI and job strenuousness has been identified by Phillipson and Lakdawalla (2002) however, I intent to further explore the casual relationship. I construct the following functional models.

Body Mass Index	=	f [*Job strenuousness*, vector of exogenous variables, health status prior to job choice (< 16 yrs), number of restaurants per state per thousand residents, PC games]	(1)
Job Strenuousness	=	f [*BMI*, *v*ector of exogenous variables]	(2)

The exogenous variables included in both models are the log of food stamps, the log of dollars spent eating out, employment status, total hours worked per year, housework hours per week, father occupation, mother occupation, highest education level, used the Internet, smoking habits, drinking alcohol habits, current health, U.S. divisions, urban/rural measurement, age, male, marital status, race, and religion. These variables are exogenous and should be included in the structural equation (2). The variables can have direct effects on job strenuousness, not indirectly through BMI.

Equations (3) and (4) show the empirical specifications of the prior theoretical equations. The equation (3) includes job strenuousness, the vector X of exogenous variables, the vector Z of instrumental variables, and an error term, u_i. The strenuousness structural equation (4) includes BMI, the vector X of exogenous variables, and an error term, ν_i.

$$\text{BMI} = ß_1 \text{ Strenuousness} + Xß + Z\gamma + u_i \quad (3)$$

$$\text{Strenuousness} = \alpha_1 \text{ BMI} + X\alpha + \nu_i \quad (4)$$

I first discuss the instrument selection and relevance and then provide a short explanation for each exogenous variable's inclusion in the models (3) and (4).

In equation (3), the proposed IVs are youth health, playing PC games at home, and the number of restaurants per state per thousand residents. Youth health represents the relative health of a person before their career selection. How healthy a person feels at age 16 has an effect on their BMI and an indirect effect on the strenuousness of their job later in life. Although not available in the PSID, a more useful instrument for BMI would be the persons actual BMI at youth. Being able to compare youth BMI prior to job choice and current BMI after job choice would be an ideal measure to determine if the job chosen caused BMI to increase or the person's BMI was high at age 16 therefore they selected a less strenuous job. Currently, I use the youth 'health' measure as one of the IVs for BMI.

PC_games is an indicator variable signifying if a person has played PC games at home in the past year. Using leisure time to play games on the PC instead of choosing an activity that burns calories has a direct effect on BMI. Outside of possibly some computer industry jobs, playing games on the computer does not have a direct effect on the strenuousness of the job chosen. There are 3,947 missing observations measuring PC game use. In order to retain these observations, I set the missing values equal to zero and included an extra variable to indicate which observations were originally missing values. I treat missing values the same way for several other variables. The missing indicator variables can be seen in the data summary table.

The number of restaurant establishments per thousand residents per state is included as an IV for BMI. The number of restaurants available per person is an indicator of the availability of calories. This variable is obtained from the Census Bureau's Economic Census 2002.

In the following data section, I describe each variable in detail. In the analysis section I test the assumptions that these instruments do not belong in the strenuousness equation and do belong in the BMI equation.

Some personal variables are included to control for economic status differences. The log of food stamp benefits received is included. The log of dollars spent eating out per week is included to give indication of the effects of disposable income on job strenuousness. These variables show the effects on job strenuousness and BMI by indicating the availability of calories.

Employment status is a series of nine indicator variables controlling for differences in current job status. Work status is described as employed, temporarily unemployed, unemployed, retired, disabled, 'keeping house', student, in jail, or not applicable. Based on previous research by Paraponaris, Saliba, and Ventelou (2005), persons that are unemployed are more likely to have a higher BMI. Because job strenuousness is not available for the unemployed, in order to include these observations I assume the unemployed have a job strenuousness of zero. Taking this assumption into account, by including the unemployed, the coefficient on BMI will be biased downward.

The total number of hours worked per year control for differences between someone with a part-time or full-time job. The number of housework hours control for the difference in home production (as a form of physical exertion) between individuals.

Father and mother occupation variables control for any predisposed family driven occupation. The highest educational degree obtained variable is used in equation (3) because some studies have shown that the more educated a person is, the less likely they are to be obese (Nayga, 2001). The highest degree obtained variable in equation (4) also controls for the effects of human capital on occupational choice. Drinking alcohol and smoking are indicator variables used as relative health and risk measures. Current health refers to the person's health status as reported by the participant and is included to control for other health causes of obesity.

Popkin (1999) finds that urbanization is a factor contributing to obesity. Lower income countries and urbanization affect the likelihood of obesity. Two series of indicator variables are used to control for regional and density effects. Urbanization may contribute to job choice because the type of jobs that are available, in terms of strenuousness, may be different in rural and urban areas. The same may be true for different U.S. regions. There are nine divisional indicator variables defined by the U.S. Census and ten regional indicator variables defined by the Beale-Ross Rural-Urban Continuum Code. The U.S. division variables control for regional effects. The rural-urban variables control for urbanization and population density.

Other inherent differences are controlled for by including physical characteristics like age, male, marital status, race, and religion. Age can be a contributing factor to BMI and job strenuousness. As we age, our bodies require fewer calories to sustain our weight and the body's metabolism slows down. Age also controls for effects of human capital increases over time on occupational choice. The variable *male* controls for inherent differences in the sexes seen in BMI and job choice.

The married series of indicator variables control for differences in married, never married, divorced, separated, annulled, and widowed persons. A person's marital status is a factor when analyzing obesity because married individuals are more likely to be obese (Jo 2004). Marital status could also affect job choice. Married individuals may select less dangerous and therefore less strenuous occupations.

A pair of indicator variables is included to control for intrinsic personal differences. Three race indicator variables (white, black, and other) are included to account for possible race differences. The difference in races may affect weight or height, therefore affecting BMI and job choice. Although there are affirmative action programs, job choices in less strenuous jobs may be limited for some minorities.

A series of six religion indicator variables are included to control for possible differences in job choice and BMI attributable to a person's faith. Work ethics taught by each faith may differ, leading to different levels of job strenuousness chosen. The indicator variables include the categories Catholic, Jewish, Protestant, other non-Christian, Orthodox, and other.

To explain the causal relationship, I estimate equation (4) using two-stage least squares (2SLS). Performing 2SLS analysis will allow me to test if BMI changes lead to a job choice change based on strenuousness.

DATA

I first look at the difficulties in defining “obesity” and “strenuousness”. According to the CDC (2006), overweight and obesity ranges in adults are measured using a person’s height and weight to determine their body mass index (BMI). For most individuals, BMI is used because it correlates with their amount of body fat (CDC 2006). Determining a person’s actual body fat percentage is the best indicator of physical fitness however, that measure is not readily available. Because measuring a person’s height and weight is much more prevalent, it is standard to assume BMI is the next best measure of physical fitness. BMI is a poor measure of physical fitness on occasions when a person has excess muscle mass. Adults with a BMI of 25.0 to 29.9 are considered overweight, while individuals with a BMI greater than 30.0 are considered obese. The CDC calculates a person’s BMI as follows:

$$BMI = \frac{weight}{(height \times height)} \times 703 \qquad (5)$$

*Weight is measured in pounds and height in inches.

Defining job strenuousness is more difficult. Job strenuousness is the physical strain on the body at work. There are limited data defining job strenuousness. In past research, Tomas Philipson uses the *Dictionary of Occupational Titles* (DOT) by the Bureau of Labor Statistics. In recent years, the Dictionary of Occupational Titles has been replaced by the Occupational Information Network (O*Net). In my analysis, I use the more current database of job strenuousness available in O*Net. When updated physical ability levels are missing in O*Net, I use the DOT values in order to retain observations.

O*Net is a comprehensive database of worker attributes and job characteristics. O*Net uses a scale of 0-100 in seven different strength categories to measure physical activity at work.

O*Net also assigns an ‘importance’ level on a scale of 0-100 for each type of strength category per job code. The ‘importance’ level gives a measure of how important that strength type is to the job position. The DOT database values use the same definitions and values for measurement however; the DOT does not include an ‘importance’ level. In order to include the DOT measures in place of missing O*Net values, I assume all DOT measures have an importance of 50. To insure this assumption does not change my regression results, in the appendix, I include a regression without using the DOT measured observations. When excluding the DOT measured observations, the significance of the result on BMI is unchanged.

The seven measures of physical ability, defined by O*Net (2005) are:

- Dynamic Flexibility — The ability to quickly and repeatedly bend, stretch, twist, or reach out with your body, arms, and/or legs.
- Dynamic Strength — The ability to exert muscle force repeatedly or continuously over time. This involves muscular endurance and resistance to muscle fatigue.
- Explosive Strength — The ability to use short bursts of muscle force to propel oneself (as in jumping or sprinting), or to throw an object.
- Extent Flexibility — The ability to bend, stretch, twist, or reach with your body, arms, and/or legs.
- Stamina — The ability to exert yourself physically over long periods of time without getting winded or out of breath.
- Static Strength — The ability to exert maximum muscle force to lift, push, pull, or carry objects.
- Trunk Strength — The ability to use your abdominal and lower back muscles to support part of the body repeatedly or continuously over time without 'giving out' or fatiguing.

I paired these seven levels of physical activity with the 2000 census job code to assign the strength values to each person surveyed in the Panel Study of Income Dynamics (PSID). The PSID is a longitudinal survey consisting of approximately 12,000 U.S. individuals and their families. I used the most recent PSID survey conducted in 2002 for my analysis.

By incorporating all seven measures of physical activity using principal component analysis, I present a single calculated measure of occupational physical strenuousness. The variables collected from the PSID, O*Net, and DOT are summarized in table 1.

Table 1

Data Summary

Variable Description	Mean	Std Dev	Min	Max
Strenuousness measure	1.83e-09	1	-1.1036	3.9377
Body Mass Index	27.328	5.532018	14.94	64.67
IV: Health at age <16	1.6930	.91496	1	5
IV: # of restaurants per state per 1000 residents	.6671	.1157	.071	1.09
Actual age in years	41.016	12.079	16	87
Number of kids in hhold	.9929	1.1589	0	8
Total hours worked/yr	1925.44	794.62	0	5376
Log of food stamps	.4477	1.716	0	13.815
Log $ spent eating out per week	2.3323	1.8179	-2.2072	6.3969
Housework hours per week	10.621	9.6816	0	105
2000 Census code – Father	451.96	354.72	0	983
2000 Census code – Mother	221.43	280.90	0	983
Highest Education Level – years	12.13685	3.998787	0	17
Current Health 1(poor) – 5(excellent)	2.26448	.98997	1	5

Table 1

Data Summary (continued)

Indicator Variables Description	**Percent of Observations = 1**	**Indicator Variables Description**	**Percent of Observations = 1**
Used Internet at home =1	24.6%	Completely Urban =1	24.2%
Smoke=1	24.8	Urban/Rural scale 2 =1	16.0
Alcohol=1	61.8	Urban/Rural scale 3 =1	25.2
Race White = 1	34.8	Urban/Rural scale 4 =1	7.6
Race Black=1	47.8	Urban/Rural scale 5 =1	3.4
Race Other =1	17.3	Urban/Rural scale 6 =1	3.4
Laid off/maternity/sick=1	54	Urban/Rural scale 7 =1	7.1
Employed now =1	84.3	Urban/Rural scale 8 =1	9.3
Unemployed =1	8.1	Urban/Rural scale 9 =1	1.2
Retired=1	2.2	Completely Rural =1	2.2
Disabled=1	0.9	New England=1	9.5
Keeping House=1	2.5	Mid-Atlantic=1	15.1
Student=1	0.7	East North Central=1	13.8
Other work =1	0.05	West North Central=1	11.5
Protestant =1	61.8	South Atlantic=1	12.2
Catholic = 1	19.2	East South Central=1	4.9
Jewish = 1	2	West South Central=1	11.8
Other non-Christian =1	1.3	Mountain=1	8.6
Orthodox =1	0.05	Pacific =1	12.4
Other =1	15.5	IV: Played PC Games =1	18.5
Youth health missing =1	1.2	Male=1	50.4
Urban/rural missing =1	0.05	Married=1	67.5
Ln $ spent eating out missing	13.1	Never Married=1	15.9
PC games missing=1	71.3	Widowed=1	1.6
Used internet missing=1	71.3	Divorced=1	11.4
Housework hrs missing=1	0.03%	Annulled=1	3.5%

ANALYSIS

In this analysis section I explain my sample selection and potential bias in detail. I then define job strenuousness, identify the simultaneous equations, and test the model assumptions.

Sample Selection

The total number of observations used in the regression analysis is 5,539. Shown in table 2, various observations were dropped for missing or invalid data. The dropped observations and the resulting bias are discussed in detail.

Table 2

Sample Selection

	Remaining Observations
Original PSID sample	12,003
Delete all observations with non-reported BMI (Height and/or weight)	11,720
Delete all observations with non-reported job code in PSID	9,430
Add strenuousness as zero if unemployed	9,845
Add strenuousness as zero if retired	9,960
Add strenuousness as zero if disabled	10,000
Add strenuousness as zero if keeping house but housework hours are < 10 /wk	10,020
Delete all observations with non-reported state or foreign country in PSID	9,983
Delete all observations with missing O*Net or DOT activity variable values	5,539

Note: Final Sample 5,539 observations

In addition to the unemployed bias on BMI discussed previously, missing values for height and/or weight also present a bias problem. The missing values create a problem because in equation (3), the endogenous variable, *BMI*, is affected by self-selective non-reporting bias. The non-willingness to report accurate height and weight could be a specific group of persons with very high or low weights. If a person reports a lower weight or greater height then their actual values, the coefficient on BMI is biased upward. On the other hand, underweight men may report higher then actual weights. This inaccurate reporting of weight would bias the coefficient on BMI downward. The opposing biases on BMI could be removed by reporting an accurate height and weight measurement of each individual. Considering all possible biases on BMI, it is unclear as to which effect is the strongest.

The *strenuousness* variable also contains missing values. Approximately 2,300 observations from the PSID are missing a corresponding job code. For the bias to be upward, the people that chose not to report their job would be a highly skilled worker that has low strenuousness levels. For the bias to be downward, the people that chose not to report may be ashamed of the low skill manual labor job that has high strenuousness levels.

Approximately 600 of the missing job code observations could be explained by the unemployed, retired, or disabled. In order to include these missing observations, I assume that if a person is unemployed, retired, or disabled, their current job strenuousness is zero. Also, respondents that report work status as ‘keeping house’ do not have a job code. If a person responded as ‘keeping house’ and they respond that they spend less then ten hours per week doing housework, I assume their strenuousness levels are zero. This assumption retains an additional twenty observations.

The primary source of the missing observations is O*Net not reporting physical activity measures for every job type. The lack of ‘strenuous’ measure per job code, accounts for approximately 8,000 missing observations. The O*Net system uses seven separate measures of strenuousness linked to the 2000 census job codes. Its predecessor, *Dictionary of Occupational Titles* (DOT), also uses seven measures and is linked to the 1970 census job codes. In order to include some of these 8,000 observations, when O*Net does not have an observed strenuousness measure, I consulted the DOT for the corresponding values. By using O*Net and DOT, my final sample includes 5,539 observations.

Defining Strenuousness

Physical activity in the workplace has been defined as a combination of seven types of strenuousness and importance levels. It is the seven levels combined that make up the endogenous variable strenuousness. According to O*Net (2005), the importance rating indicates how important a particular physical activity descriptor is to the occupation. The possible ratings range from ‘Not Important’ (1) to ‘Extremely Important’ (5). O*Net normalized these ratings from 1-5 to a scale of 0-100.

I first make the consideration that ‘importance’ and ‘level’ of strenuousness can be equated to ‘duration’ and ‘intensity’ of exercise. I then consider how the ‘importance’ and ‘level’ measures should be combined. In a trial by Jakicic, Marcus, Gallagher, Napolitano, and Lang (2003), they find that there is no statistically significant difference between varying intensity and duration of exercise in terms of weight loss and cardiovascular fitness. With these results, I conclude that for example a strength measure of 90 and an importance measure of 30 is equally strenuous as an importance measure of 90 and a strength measure of 30. Assuming this, I simply multiply the level by the importance factor. The product results are used in the principal component analysis (PCA).

PCA is a statistical technique for data reduction. PCA transforms the seven strenuousness variables into one expression of the linear combinations standardized to mean zero and variance of one. PCA finds the linear combinations of the variables with the greatest variance while preserving as much of the original information content possible (StataCorp 2003). My first results for PCA are in table 3.

Table 3

Principal Component Analysis

				EIGENVECTORS
Component	EIGENVALUE		**Variable**	**Component 1**
1	5.68786		**Dynamic_flex**	0.3682
2	.422356		**Dynamic_strength**	0.3918
3	.281288		**Explosive_s**	0.3607
4	.245137		**Extent_flex**	0.3845
5	.134314		**Stamina**	0.3778
6	.120681		**Static_s**	0.3914
7	.108365		**Trunk_s**	0.3702

I chose to retain the first component for two reasons. The first component accounts for 81.3% of the variance in the seven variables and the second component's Eigenvalue is well below one. I obtain the strenuousness combined variable by standardizing the seven variables then combining them into one weighted equation that defines strenuousness. The remainder of the analysis regarding the endogenous variable, strenuousness, is in terms of these "standardized" variables representing the seven factors of strenuousness.

<u>Identification</u>

I first verify that the instrumental variables are jointly correlated with BMI and the IVs do not belong in the strenuousness equation.

I impose exclusion restrictions on the strenuousness structural model. The order condition holds when the exogenous variables (youth health, PC games, and restaurants per state per thousand residents*)* do not belong in the strenuousness equation. The rank condition for identification of a structural equation states that the strenuousness equation in a two-equation simultaneous equations model is identified if and only if the BMI equation contains at least one exogenous variable (with a non-zero coefficient) that is excluded from the strenuousness equation. The rank condition is necessary and sufficient for the strenuousness equation to be identified. The first assumption tested below shows that number of restaurants per state per thousand residents, PC games, and youth health do not belong in the strenuousness equation.

The two well-known assumptions required to obtain consistent β estimators are: the IVs must be correlated with the included endogenous variable, BMI, after controlling for all other exogenous variables, and all IVs need to be uncorrelated with the error term in the structural equation.

I test the first relevance assumption that the IVs must be correlated with BMI after controlling for all other exogenous variables by examining the first stage F-test results. The null hypothesis states that the coefficients on the three potential IVs are equal to zero. With the p-value of 0.0000 seen in table 4, I reject the null hypothesis. The number of restaurants per state per thousand residents, PC games, and youth health are jointly correlated with BMI at the five percent significance level. Also looking at the first stage F-test, I examine the strength of the IVs. The first stage regression result of 11.43 is greater than the widely accepted critical value of 10. This result indicates that the power of the three IVs to explain BMI is not weak.

It is important to note the effects of potentially weak IVs on the analysis are considered and corrected when possible. Weak IVs affect estimators and standard errors in 2SLS regressions as well as over-identification (OID) and Hausman test results. Weak IVs can cause the 2SLS estimators to be biased towards OLS; therefore the Hausman test may fail to reject OLS when it should reject (Hahn and Hausman 2003). Weak IVs can potentially cause the OID test to reject more often then it should (Hahn and Hausman 2003).

Table 4

First Stage F-test Results

Partial R-squared of excluded instruments: 0.0058 Test of excluded instruments: F(3, 5479) = 11.43
Prob > F = 0.0000
Note: first-stage F-stat heteroskedasticity-robust
… Hansen J statistic (overidentification test of all instruments): 4.556 Chi-sq(2) P-val = 0.10250

Because the number of instruments excluded from the structural equation (4) exceeds the number of included endogenous variables, the second assumption can be tested using an over-identification (OID) test. Using the Hansen J statistic's p-value of 0.10250 shown in table 4, under the null hypothesis that all IVs are uncorrelated with the error, ν_I, I fail to reject the null hypothesis and conclude that at least some of the IVs are exogenous. The instruments do not belong in the structural equation (4). The IV combination of the number of restaurants per state per thousand residents, PC games, and youth health are uncorrelated with the error in equation (4) therefore 2SLS will be consistent.

Now that the IVs have been chosen, I must determine if BMI is endogenous while considering a possible weak instruments problem. Testing the endogeneity of BMI, I first estimate the 2SLS regression then perform the Hausman test. The results from the Hausman test are shown in table 5. With a p-value of 0.85, at the five percent significance level, the Hausman test failed to reject the null hypothesis that BMI is exogenous.

Table 5

Hausman Test Results

Tests of endogeneity of: bmi H_0: Regressor is exogenous			
2SLS			
Wu-Hausman F test:	0.03666	F(1,5480)	P-value = 0.84817
Durbin-Wu-Hausman chi-sq test:	0.03705	Chi-sq(1)	P-value = 0.84736
JN2SLS			
Wu-Hausman F test:	0.03666	F(1,5480)	P-value = 0.84817
Durbin-Wu-Hausman chi-sq test:	0.03705	Chi-sq(1)	P-value = 0.84736

This Hausman result fails to reject the use of the OLS estimation method. The results of the Hausman test means that OLS is efficient and 2SLS is consistent but inefficient. OLS is the most efficient estimation technique in that OLS is unbiased, consistent, and efficient.

To further verify my 2SLS Hausman results that indicate OLS as the best estimator, I include the jackknife estimation method in my regression analysis. Hahn and Hausman (2003) explain that the Jackknife two-stage least squares (JK2SLS) estimator calculates the reduced form equation by omitting the last observation. The JK2SLS estimator creates estimates based on generating estimates repeatedly on the data set leaving one observation out each repetition. The second-order finite sample bias of 2SLS is eliminated by using the JK2SLS estimator (Hahn and Hausman 2003). The JN2SLS estimates have a higher variance but less bias than 2SLS estimates. As shown in table 5, this Hausman test compares the JN2SLS estimators against OLS, finding in favor of OLS over JN2SLS.

The Hausman results also indicate that the point estimates are quantitatively unaffected. OLS, 2SLS, and JN2SLS all have statistically identical estimates for BMI. Because the Hausman test rejects 2SLS and JN2SLS over OLS, I show all method estimates, but I choose to explain OLS in detail.

REGRESSION RESULTS

I now run the OLS regression. To correct for potential heteroskedasticity problems, all of the regressions have included robust standard errors. For comparison and to show the estimates are not statistically significantly different between OLS, 2SLS and JN2SLS, table 6 shows the results of all three regressions. For the complete regression results see the appendix. Because I choose to use the efficient unbiased consistent estimates of OLS, I discuss the OLS estimates in depth.

Table 6

Regression Results

Note: * significant at the 5% level   ** significant at the 1% level
Robust z statistics in parentheses

Strenuousness	2SLS	OLS	JN2SLS
BMI	0.008	0.002	0.008
	(0.28)	(1.08)	(0.26)
Age	-0.001	-0.001	-0.001
	(0.49)	(0.45)	(0.48)
Male	0.424	0.432	0.424
	(9.77)**	(17.33)**	(9.18)**
Number of Kids	0.029	0.031	0.029
	(2.12)*	(2.86)**	(2.04)*
Marital Status: Never Married	0.118	0.121	0.118
	(3.14)**	(3.41)**	(3.08)**
Marital Status: Widowed	0.022	0.030	0.022
	(0.22)	(0.33)	(0.22)
Marital Status: Divorced	0.159	0.161	0.159
	(4.21)**	(4.30)**	(4.16)**

Table 6

Regression Results (continued)

Note: * significant at the 5% level ** significant at the 1% level
Robust z statistics in parentheses

Strenuousness	2SLS	OLS	JN2SLS
Marital Status: Annulled	0.130	0.135	0.130
	(2.04)*	(2.27)*	(1.98)*
Work Status: Temporary Layoff,	0.276	0.281	0.276
Sick, Maternity	(1.97)*	(2.03)*	(1.91)
Work Status: Unemployed	-1.447	-1.445	-1.447
	(46.54)**	(51.40)**	(45.24)**
Work Status: Retired	-1.237	-1.238	-1.237
	(25.69)**	(25.77)**	(25.31)**
Work Status: Disabled	-1.580	-1.577	-1.580
	(24.62)**	(24.90)**	(23.94)**
Work Status: Keeping House	-0.423	-0.419	-0.423
	(6.03)**	(6.19)**	(5.90)**
Work Status: Student	0.207	0.201	0.207
	(1.34)	(1.32)	(1.30)
Work Status: Other/Jail	-0.574	-0.572	-0.574
	(6.44)**	(7.46)**	(4.72)**
Total Hours Worked Per Year	-0.000	-0.000	-0.000
	(2.68)**	(2.89)**	(2.61)**
Housework Hours Per week	0.002	0.002	0.002
	(1.56)	(1.57)	(1.52)
Smoke	0.030	0.021	0.030
	(0.57)	(0.75)	(0.53)
Alcohol	-0.048	-0.051	-0.048
	(1.70)	(2.08)*	(1.65)
Father Occupation	0.000	0.000	0.000
	(0.69)	(0.99)	(0.66)
Mother Occupation	-0.000	-0.000	-0.000
	(0.43)	(0.38)	(0.42)

Table 6

Regression Results (continued)

Note: * significant at the 5% level ** significant at the 1% level
Robust z statistics in parentheses

Strenuousness	2SLS	OLS	JN2SLS
Race: Black	-0.144	-0.154	-0.144
	(0.79)	(0.88)	(0.71)
Race: Other	0.080	0.080	0.080
	(0.76)	(0.75)	(0.74)
Highest Education Level	-0.108	-0.109	-0.108
	(14.02)**	(18.64)**	(13.37)**
Used Internet	-0.158	-0.157	-0.158
	(2.58)**	(2.55)*	(2.55)*
Religion: Catholic	-0.075	-0.078	-0.075
	(2.23)*	(2.59)**	(2.16)*
Religion: Jewish	-0.301	-0.305	-0.301
	(4.66)**	(4.89)**	(4.56)**
Religion: Other Non-Christian	-0.114	-0.122	-0.114
	(1.02)	(1.15)	(0.99)
Religion: Orthodox	1.124	1.145	1.124
	(3.73)**	(4.03)**	(3.20)**
Religion: Other	-0.021	-0.022	-0.021
	(0.64)	(0.65)	(0.63)
Current Health	0.006	0.011	0.006
	(0.18)	(0.89)	(0.17)
Log Food Stamps	-0.013	-0.012	-0.013
	(1.23)	(1.30)	(1.18)
Log $ Spent Eating Out Per Wk	-0.016	-0.016	-0.016
	(2.26)*	(2.29)*	(2.24)*
Division 1: New England	0.110	0.105	0.110
	(0.61)	(0.59)	(0.58)
Division 2: Middle Atlantic	-0.072	-0.073	-0.072
	(1.09)	(1.11)	(1.08)
Division 3: East North Central	-0.050	-0.051	-0.050
	(0.80)	(0.81)	(0.78)

Table 6

Regression Results (continued)

Note: * significant at the 5% level ** significant at the 1% level
Robust z statistics in parentheses

Strenuousness	2SLS	OLS	JN2SLS
Division 4: West North Central	-0.043	-0.040	-0.043
	(0.57)	(0.55)	(0.56)
Division 6: East South Central	-0.214	-0.213	-0.214
	(2.60)**	(2.56)*	(2.55)*
Division 7: West South Central	0.030	0.030	0.030
	(0.42)	(0.42)	(0.42)
Division 8: Mountain	-0.151	-0.153	-0.151
	(1.67)	(1.70)	(1.64)
Division 9: Pacific	0.149	0.137	0.149
	(0.60)	(0.56)	(0.54)
Missing: Highest Education	-1.529	-1.544	-1.529
Level	(13.31)**	(16.89)**	(12.76)**
Missing: Housework	0.354	0.346	0.354
Hours/Week	(1.53)	(1.51)	(1.42)
Missing: Youth Health	0.309	0.308	0.309
	(2.74)**	(2.71)**	(2.67)**
Missing: Urban/Rural	0.251	0.295	0.251
	(0.45)	(0.57)	(0.35)
Missing: Log $ Spent	0.035	0.034	0.035
Eating Out	(0.71)	(0.68)	(0.70)
Missing: Used Internet	0.234	0.237	0.234
	(0.60)	(0.59)	(0.40)
Missing: PC Games	-0.277	-0.278	-0.277
	(0.72)	(0.69)	(0.47)
Urban/Rural 2^{nd} Most Urban	-0.031	-0.034	-0.031
	(0.84)	(0.96)	(0.82)
Urban/Rural 3^{rd} Most Urban	0.088	0.086	0.088
	(2.62)**	(2.60)**	(2.59)**

Table 6

Regression Results (continued)

Note: * significant at the 5% level ** significant at the 1% level
Robust z statistics in parentheses

Strenuousness	2SLS	OLS	JN2SLS
Urban/Rural 4th Most Urban	0.092	0.091	0.092
	(1.88)	(1.86)	(1.86)
Urban/Rural 5th Most Urban	-0.033	-0.034	-0.033
	(0.53)	(0.56)	(0.52)
Urban/Rural 6th Most Urban	0.219	0.217	0.219
	(3.30)**	(3.28)**	(3.25)**
Urban/Rural 7th Most Urban	0.123	0.120	0.123
	(2.37)*	(2.36)*	(2.33)*
Urban/Rural 8th Most Urban	0.196	0.194	0.196
	(4.15)**	(4.15)**	(4.10)**
Urban/Rural 9th Most Urban	0.256	0.261	0.256
	(2.19)*	(2.28)*	(2.14)*
Urban/Rural - Most Rural	0.233	0.228	0.233
	(2.74)**	(2.79)**	(2.68)**
Constant	1.258	1.395	1.258
	(1.80)	(10.31)**	(1.66)
Observations	5539	5539	5539
R-squared		0.32	0.32

The variable of interest is BMI. Taking into account the bias on the BMI coefficient previously discussed, the OLS results show that the coefficient on BMI is not statistically significantly different from zero with a p-value of 0.281. A person's BMI has no significant effect on the job strenuousness level choice. On average, people with different BMI's do not make different choices when choosing job positions with different strenuousness levels. To ensure that including the DOT values does not result in a bias on BMI, the appendix shows complete regression results excluding the observations that originated from the DOT database. Using 2SLS analysis results in a p-value on BMI of 0.86. This additional result confirms that a person's BMI has no significant effect on the job strenuousness level choice.

There are other notable OLS results that are significant. All of the following explanations assume the estimates are on average and holding all other variables in the model constant.

Males choose more strenuous jobs than females. As the number of children in a household increases, the job strenuousness chosen by people in that household also increases. Divorced, annulled, and never married individuals, when compared to married individuals, choose more strenuous jobs. As a person gains a year of education, the job chosen is less strenuous. As a person spends more money eating out, their job strenuousness level decreases. If a person uses the Internet at home, their job strenuousness decreases. If a person drinks alcohol, their job strenuousness decreases. Also significant is the result on the number of hours worked per year. The more hours a person works per year, the less strenuous their job.

An interesting finding is the results on religious effects. Compared to persons of the Protestant faith, on average, Jewish and Catholic people choose less strenuousness jobs and Orthodox people choose a much more strenuous job.

Several significant effects are found when discussing urbanization and U.S. regions. When compared to completely urban living persons, people living in progressively more rural areas select more strenuous jobs on average. In the U.S. this difference may be explained in part by the prevalence of farmers in rural areas. Compared to the South Atlantic division (DE, DC, FL, GA, MD, NC, SC, VA, and WV), persons residing in the East South Central division (AL, KY, MS, and TN) on average choose a less strenuous job.

A person that is temporarily laid off due to sickness or maternity chooses a more strenuous job than a working individual. An unemployed, retired, disabled, in jail, or 'keeping house' person will choose a less strenuous job when compared to a working individual. The result on three of these employment factors may primarily be due to my setting all job strenuous levels equal to zero when a person is unemployed, retired or disabled to retain these observations. If a person's work status is 'keeping house' and they reported less then ten hours of housework per week I also assume their job strenuousness is zero. To ensure my assumptions do not change the conclusions about BMI, I ran a 2SLS regression omitting the 600 unemployed, retired, and disabled observations. For complete results see the appendix. I am still able to conclude that with a p-value of 0.88, people with different BMI's do not make different choices when choosing job positions with different strenuousness levels.

CONCLUSION

The effect BMI has on job strenuousness is not statistically different from zero. I conducted an over-identification test, F-test, and Hausman test. I reviewed 2SLS, JN2SLS, and OLS regressions to ensure that the regression method chosen produced unbiased and consistent estimates. I chose to use the efficient, unbiased, consistent estimates of OLS. Using OLS and taking the survey reporting bias into account, BMI does not cause a change in job choice in terms of strenuousness. On average and holding all other variables in the model constant, a person's BMI has no significant effect on the job strenuousness level choice. My current research could be expended upon by using a better fit data source as opposed to using the PSID.

Does a person with a higher BMI choose a more sedentary job position? No. The OLS, 2SLS, and JN2SLS results show that an obese person, on average, does not choose a more sedentary job then their healthy BMI counterpart, holding all other variables in the model constant. Knowing there is a negative correlation between BMI and strenuousness, and knowing an obese person does not select a less strenuous job, I still pose the question, 'Does choosing a more sedentary job cause a person's BMI to rise?' The policy implications of my findings are, if obesity is primarily due to a change in market production, further research should be done exploring if less physically strenuous jobs produce obese people.

Moreover, if it is shown that job strenuousness is one of the main causes of the obesity epidemic in America, companies offering sedentary jobs should consider policies to reduce the correlation. Some possible policies could be subsidizing gym memberships, offering peer group meetings to support healthy eating habits, or providing an exercise facility on site. Keeping employees healthy has a direct effect on productivity and employee healthcare costs.

APPENDIX

Appendix All Complete Regression Results					
Note: * significant at the 5% level ** significant at the 1% level Robust z statistics in parentheses	2SLS	OLS	JN2SLS	2SLS Excludes Unemployed Disabled & Retired	2SLS Excludes DOT Obs.
Observations	5539	5539	5539	4913	1068
R-squared	0.11	0.32	0.32	0.12	0.32
First Stage F-Test	11.43			13.10	2.61
BMI	0.008	0.002	0.008	-0.004	0.013
	(0.28)	(1.08)	(0.26)	(0.16)	(0.18)
age	-0.001	-0.001	-0.001	-0.000	0.008
	(0.49)	(0.45)	(0.48)	(0.19)	(2.41)*
male	0.424	0.432	0.424	0.498	0.738
	(9.77)**	(17.33)**	(9.18)**	(10.29)**	(6.78)**
num_kids	0.029	0.031	0.029	0.039	0.017
	(2.12)*	(2.86)**	(2.04)*	(2.58)**	(0.55)
never_married	0.118	0.121	0.118	0.142	0.262
	(3.14)**	(3.41)**	(3.08)**	(3.27)**	(2.67)**
widowed	0.022	0.030	0.022	0.049	-0.243
	(0.22)	(0.33)	(0.22)	(0.41)	(0.90)
divorced	0.159	0.161	0.159	0.177	0.304
	(4.21)**	(4.30)**	(4.16)**	(4.19)**	(2.38)*
annulled	0.130	0.135	0.130	0.146	0.170
	(2.04)*	(2.27)*	(1.98)*	(1.99)*	(1.10)
work_temp_layoff_ sick_maternity	0.276	0.281	0.276	0.266	0.032
	(1.97)*	(2.03)*	(1.91)	(1.92)	(0.10)
work_unemployed	-1.447	-1.445	-1.447		-1.728
	(46.54)**	(51.40)**	(45.24)**		(18.65)**
work_retired	-1.237	-1.238	-1.237		-1.968
	(25.69)**	(25.77)**	(25.31)**		(8.58)**
work_disabled	-1.580	-1.577	-1.580		-2.009
	(24.62)**	(24.90)**	(23.94)**		(8.20)**
work_keeping_house	-0.423	-0.419	-0.423	-0.421	-0.553
	(6.03)**	(6.19)**	(5.90)**	(5.68)**	(2.70)**
work_student	0.207	0.201	0.207	0.183	0.622
	(1.34)	(1.32)	(1.30)	(1.19)	(1.59)
work_other_jail	-0.574	-0.572	-0.574	-0.571	
	(6.44)**	(7.46)**	(4.72)**	(9.19)**	
total_hrs_worked_yr	-0.000	-0.000	-0.000	-0.000	-0.000
	(2.68)**	(2.89)**	(2.61)**	(2.72)**	(2.76)**

Appendix

All Complete Regression Results (continued)

Note: * significant at the 5% level ** significant at the 1% level Robust z statistics in parentheses	2SLS	OLS	JN2SLS	2SLS Excludes Unemployed Disabled & Retired	2SLS Excludes DOT Obs.
housework_hrs_wk	0.002	0.002	0.002	0.002	0.000
	(1.56)	(1.57)	(1.52)	(1.21)	(0.11)
smoke	0.030	0.021	0.030	0.015	0.089
	(0.57)	(0.75)	(0.53)	(0.30)	(0.50)
alcohol	-0.048	-0.051	-0.048	-0.062	-0.063
	(1.70)	(2.08)*	(1.65)	(2.06)*	(0.86)
father_occ	0.000	0.000	0.000	0.000	0.000
	(0.69)	(0.99)	(0.66)	(0.90)	(0.49)
mother_occ	-0.000	-0.000	-0.000	-0.000	0.000
	(0.43)	(0.38)	(0.42)	(0.05)	(0.26)
race_black	-0.144	-0.154	-0.144	-0.048	-0.504
	(0.79)	(0.88)	(0.71)	(0.24)	(0.99)
race_other	0.080	0.080	0.080	0.107	-0.061
	(0.76)	(0.75)	(0.74)	(0.88)	(0.22)
highest_education_lvl	-0.108	-0.109	-0.108	-0.120	-0.130
	(14.02)**	(18.64)**	(13.37)**	(14.95)**	(5.48)**
used_internet	-0.158	-0.157	-0.158	-0.180	-0.157
	(2.58)**	(2.55)*	(2.55)*	(2.69)**	(0.89)
religion_catholic	-0.075	-0.078	-0.075	-0.090	-0.105
	(2.23)*	(2.59)**	(2.16)*	(2.51)*	(1.16)
religion_jewish	-0.301	-0.305	-0.301	-0.343	-0.979
	(4.66)**	(4.89)**	(4.56)**	(5.07)**	(4.44)**
religion_other_nonchristian	-0.114	-0.122	-0.114	-0.140	0.283
	(1.02)	(1.15)	(0.99)	(1.14)	(0.93)
religion_orthodox	1.124	1.145	1.124	1.409	
	(3.73)**	(4.03)**	(3.20)**	(4.31)**	
religion_other	-0.021	-0.022	-0.021	-0.032	-0.107
	(0.64)	(0.65)	(0.63)	(0.85)	(1.02)
current_health	0.006	0.011	0.006	0.020	0.040
	(0.18)	(0.89)	(0.17)	(0.60)	(0.52)
lnfood_stamps_adj	-0.013	-0.012	-0.013	-0.010	-0.024
	(1.23)	(1.30)	(1.18)	(0.82)	(0.67)
lnspent_out_per_wk	-0.016	-0.016	-0.016	-0.018	-0.011
	(2.26)*	(2.29)*	(2.24)*	(2.25)*	(0.49)
div1_NE	0.110	0.105	0.110	0.119	-1.411
	(0.61)	(0.59)	(0.58)	(0.63)	(6.87)**
div2_MA	-0.072	-0.073	-0.072	-0.077	-0.211
	(1.09)	(1.11)	(1.08)	(1.06)	(0.96)
div3_ENC	-0.050	-0.051	-0.050	-0.073	-0.137
	(0.80)	(0.81)	(0.78)	(1.03)	(0.71)
div4_WNC	-0.043	-0.040	-0.043	-0.046	-0.158
	(0.57)	(0.55)	(0.56)	(0.58)	(0.79)
div6_ESC	-0.214	-0.213	-0.214	-0.206	-0.691
	(2.60)**	(2.56)*	(2.55)*	(2.16)*	(2.82)**

Appendix

All Complete Regression Results (continued)

Note: * significant at the 5% level ** significant at the 1% level Robust z statistics in parentheses	2SLS	OLS	JN2SLS	2SLS Excludes Unemployed Disabled & Retired	2SLS Excludes DOT Obs.
div7_WSC	0.030	0.030	0.030	0.038	0.139
	(0.42)	(0.42)	(0.42)	(0.48)	(0.58)
div8_M	-0.151	-0.153	-0.151	-0.131	-0.438
	(1.67)	(1.70)	(1.64)	(1.32)	(1.71)
div9_P	0.149	0.137	0.149	0.076	1.271
	(0.60)	(0.56)	(0.54)	(0.28)	(6.71)**
education_missing	-1.529	-1.544	-1.529	-1.724	-1.681
	(13.31)**	(16.89)**	(12.76)**	(14.40)**	(4.30)**
housework_missing	0.354	0.346	0.354	0.434	0.881
	(1.53)	(1.51)	(1.42)	(1.37)	(2.91)**
youth_health_missing	0.309	0.308	0.309	0.364	-0.023
	(2.74)**	(2.71)**	(2.67)**	(2.75)**	(0.08)
urban_rural_missing	0.251	0.295	0.251	0.319	-0.595
	(0.45)	(0.57)	(0.35)	(0.47)	(1.06)
lnspent_out_missing	0.035	0.034	0.035	0.048	-0.109
	(0.71)	(0.68)	(0.70)	(0.80)	(0.65)
used_internet_missing	0.234	0.237	0.234	0.304	0.938
	(0.60)	(0.59)	(0.40)	(0.49)	(2.37)*
pc_games_missing	-0.277	-0.278	-0.277	-0.353	-0.998
	(0.72)	(0.69)	(0.47)	(0.57)	(2.68)**
urban_rural2	-0.031	-0.034	-0.031	-0.045	-0.084
	(0.84)	(0.96)	(0.82)	(1.06)	(0.58)
urban_rural3	0.088	0.086	0.088	0.102	0.092
	(2.62)**	(2.60)**	(2.59)**	(2.66)**	(0.84)
urban_rural4	0.092	0.091	0.092	0.113	0.338
	(1.88)	(1.86)	(1.86)	(2.09)*	(1.85)
urban_rural5	-0.033	-0.034	-0.033	-0.032	-0.163
	(0.53)	(0.56)	(0.52)	(0.47)	(0.84)
urban_rural6	0.219	0.217	0.219	0.265	0.359
	(3.30)**	(3.28)**	(3.25)**	(3.41)**	(1.77)
urban_rural7	0.123	0.120	0.123	0.144	0.058
	(2.37)*	(2.36)*	(2.33)*	(2.45)*	(0.41)
urban_rural8	0.196	0.194	0.196	0.215	0.281
	(4.15)**	(4.15)**	(4.10)**	(4.09)**	(2.44)*
urban_rural9	0.256	0.261	0.256	0.305	0.776
	(2.19)*	(2.28)*	(2.14)*	(2.38)*	(3.31)**
urban_rural10	0.233	0.228	0.233	0.271	0.212
	(2.74)**	(2.79)**	(2.68)**	(2.87)**	(1.06)
work_na		0.000			
		(.)			
Constant	1.258	1.395	1.258	1.673	1.103
	(1.80)	(10.31)**	(1.66)	(2.42)*	(0.53)

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