Working Yourself to Death? The Relationship Between Work Hours and Obesity

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Abstract

Work hours may affect obesity if reduced leisure time decreases exercise and causes substitution from meals prepared at home to fast food and pre-prepared processed food. Additional work by adults may also impact child weight by reducing parental supervision. I find that a rise in work hours increases one's weight and, to a lesser extent, the weight of one's spouse. Mothers', but not fathers', work hours affect child weight. I also find that a rise in work hours is associated with a decrease in exercise and an increase in purchasing food prepared away from home. My estimates imply that changes in labor force participation account for 6% and 10% of the growth in adult and childhood obesity in recent decades.

Keywords: Work hours, obesity, body weight, employment, labor force

JEL Classification: I10

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1 Introduction

A person is considered clinically obese if he or she has a body mass index (BMI = weight in kg divided by height in meters squared) of 30 or greater. Despite the fact that technological advancements in medicine generally improved the health of the population in the past half-century, the percentage of adults in America who are classified as obese rose dramatically during this time, from 12.8% in 1960-62 to 32.2% in 2003-04 (Flegal et al, 1998; Ogden et al 2006). The outlook is no more encouraging for children and young adults. In 1963-70, 4% of children ages 6-11 and 5% of adolescents ages 12-19 were overweight.[1] By 1999-2002, these percentages had risen to 16% for each (Hedley et al, 2004). Excessive weight has become a critical public health concern. Obesity is now the second-leading cause of preventable deaths in the country behind smoking, accounting for approximately 112,000 deaths per year, and studies have linked it to high blood pressure, diabetes, heart disease, stroke, and a number of other adverse health conditions (Flegal et al, 2005). Consequences of obesity also include an estimated $117 billion in medical and related costs per year (U.S. Department of Health and Human Services, 2001).

Another obvious trend in the U.S. in the second half of the 20th Century was the widespread movement of women into the labor force. In 1950, the labor force participation rate for women ages sixteen and older was 34%; by 2004, this percentage had risen to 59%. While men reduced their market work somewhat in response, the labor force participation rate for the entire adult population still rose from 59% to 66% during this time (Bureau of Labor Statistics, 2007).

The fact that America's weight gain has coincided with the increase in labor force participation (see Figure 1) suggests that a causal relationship between these trends may be

[1] Children and adolescents are classified as "overweight" if they have a BMI at or above the 95th percentile based on age- and gender-specific growth charts. With children and adolescents, the term "obese" is used interchangeably with "overweight." Percentiles are determined using child BMI data from the second and third National Health Examination Surveys (NHES II and NHES III) and from the first, second, and third National Health and Nutrition Examination Surveys (NHANES I, NHANES II, and NHANES III). These surveys spanned the period 1963-1994; therefore, the percentage of children who are overweight is not fixed at 5%.

possible. In theory, an individual working more hours could limit available time for exercise, causing her to gain weight. She could also devote less time to food preparation, causing a substitution from home-prepared meals to less healthy convenience food, such as fast food and pre-prepared processed food, resulting in a weight gain for herself as well as other family members. Moreover, parents working could limit the amount of supervision their children receive, allowing them to make less healthy eating and exercise decisions.

In this paper, I attempt to determine the relationship between adult work hours and the weight of both adults and children. Applying differencing methods to panel data from the National Longitudinal Survey of Youth (NLSY) and NLSY Child Supplement (NLSYCS), I find that an increase in a man or woman's work hours increases the person's own weight and, to a lesser extent, the weight of his or her spouse. Employing an instrumental variables approach, I show that this effect occurs by reducing exercise and increasing the percentage of the family's food budget used to purchase food from restaurants. I also conclude that mothers', but not fathers', work hours affect the weight of children. Ultimately, I estimate that changing employment patterns account for 6% of the rise in adult obesity between 1961 and 2004 and 10% of the increase in overweight children from 1968 to 2001.

2 Literature Review

Most of the literature on work hours and body weight focuses on the effect of maternal employment on childhood obesity. Using data from the NLSY matched with the NLSYCS, Anderson, Butcher, and Levine (2003) (ABL) found that a mother working 10 additional hours per week over the course of a child's life (ages 3-11) is associated with a 1 percentage point increase in the probability that the child is overweight. ABL argue that estimates of the work hour effect could suffer from unobserved heterogeneity. Mothers who work may simply be those who are less concerned with their children's health, creating a spurious negative relationship. On the other hand, ambitious mothers may both work and value health, biasing the effect upward. ABL therefore implement differences and instrumental variables approaches, but these estimates are similar to those using a simple linear probability model, suggesting that the extent of the unobserved heterogeneity is minimal.

Ruhm (2004) estimates the relationship between a mother's work hours and several outcomes for children ages 10 and 11, including body weight. He uses the same NLSY Child Supplement data as ABL. Ruhm finds that 20 additional mother's work hours per week over the course of the child's life is associated with approximately a 2 percentage point increase in the child's probability of being overweight and a 3 percentage point increase in its probability of being at risk of becoming overweight (BMI above the 85th percentile). He also shows that the effect is stronger for children in higher socioeconomic status families. Fertig et al (2006) attempt to determine the mechanisms through which maternal employment affects childhood obesity. Using data from the Child Development Supplement of the Panel Study of Income Dynamics, they find that mother's work hours affect children's weight primarily by influencing supervision and nutrition.

The relationship between work hours and adult weight is not as well explored. Chou et al (2004) used data from the Behavioral Risk Factor Surveillance System (BRFSS) to estimate the relationship between a variety of state-level characteristics and weight. In the working paper version of this paper (2002), they also found a correlation between state-level measures of hours worked and wages and the weight of individuals living in the state.[2] They interpreted this as evidence that improved labor market opportunities, reflected by the movement of women into the labor force, have contributed to the growth in obesity. They hypothesized that improved earning potential led to more work hours and therefore less time for food preparation, stimulating demand for convenience food. In an effort to explain his finding that smoking and obesity fall in recessions, Ruhm (2005) conducts a similar estimation of the relationship between state-level work hours and individual weight and obtains similar results. Ko et al (2007) find a positive association between work hours and BMI in adults in Hong

[2]They divided the state-level data into sixty-four groups based on year, gender, race, marital status, age, and education, and assigned each person a predicted hours and wage that corresponded to his/her group.

Kong with cross-sectional data. However, the study does not make an attempt to distinguish between correlation and causality, and the authors write that "further studies are needed to investigate the underlying mechanisms of this relationship ..." (p. 254).

Lakdawalla and Philipson (2007) use NLSY panel data to study a related but different question: how do the physical demands of one's job affect body weight? They show that working at sedentary or strength-demanding (and therefore muscle-building) occupations is associated with a higher weight than working at fitness-demanding occupations.

In this paper, I contribute to the literature primarily by providing a more complete analysis of the link between work hours and adult weight. To my knowledge, this is the first paper to estimate the effect of individual-level work hours on adult body weight using panel data to eliminate time-invariant sources of omitted variable bias in the estimates. I also provide direct evidence that the work hour effect occurs through the expected mechanisms: decreasing exercise and inducing a substitution toward food prepared at restaurants. Additionally, I differentiate between work hour effects on the basis of gender, marital status, spouse work status, and employment sector. Finally, I show that work hours affect only the weight of individuals who are at risk for obesity, suggesting that the effect of work hours on weight is particularly hazardous to health.

My primary contribution to the childhood obesity literature lies in exploring the impact of mothers' spouses' work hours, instead of only mothers' work hours, on child weight. In response to increases in female employment, the percentage of adult men who work fell from 83% in 1950 to 73% in 2004 (Bureau of Labor Statistics, 2007). If men are perfect substitutes for women in terms of child care, the effect of more women working on the prevalence of overweight children would be partially offset by the fact that more men stay at home. I also contribute by utilizing a broader range of data than previous authors, as I include children ages 3-17 as well as four more waves of NLSY data than ABL.

3 Analytical Framework

In this section, I develop a simple structural model of the effect of work hours on adult body weight, assuming that this effect occurs through reducing exercise and inducing substitution from home-cooked meals to food prepared outside the home. I define the body mass index of a representative agent as

$$BMI_T = BMI_0(S, R, I, G) + \sum_{t=0}^{T} r(C_t - B_t) \tag{1}$$

where BMI_0 is a person's initial BMI as determined by genetic factors such as sex (S), race (R), natural intelligence (I), and other unobservable genetic attributes (G). A person's change in BMI in period t is equal to the difference between her calories consumed (C) and burned (B) in t, multiplied by the rate (r) at which this caloric balance is converted to units of BMI. Therefore, BMI acts as a capital stock in that it depends on a person's decisions in all preceding periods.

People generally assume food prepared at restaurants to be, on average, less healthy than food prepared at home. A variety of research finds a positive correlation between frequency of eating fast food and consumption of calories, fat, and saturated fat (for an example, see Satia et al, 2004). Both the popular press and scholarly research have also criticized the health quality of full-service restaurant meals, mainly for their increasingly large portions (Young and Nestle, 2002) and use of hidden high-calorie flavor-enhancers such as butter and oil ("Deadly Secrets ..."). Therefore, number of calories consumed depends on the percentage of meals eaten out or delivered. Calories burned are a function of amount of exercise. Wage, education, marital status, age, number of children, health limitations, and pregnancies may also affect body weight.[3] I therefore model calories consumed and burned by the following

[3] In developed countries, earnings tend to be inversely related to BMI for most of the income distribution. This may be because healthy foods, such as fruits, vegetables, and lean meats, are more expensive than pre-prepared processed foods and other less healthy foods (Lakdawalla and Philipson, 2002). Education appears to be inversely related to BMI, suggesting that schooling helps people to make more informed eating and exercise decisions (Nayga, 2001). Several papers suggest that BMI increases when people marry or grow older

equations:

$$C_t = C(P_t, X_t) \tag{2}$$

$$B_t = B(E_t, X_t) \tag{3}$$

where X is a set of the aforementioned descriptive/demographic variables, P is the percentage of meals prepared by restaurants, and E = amount of exercise.

If a person works more hours, she has less available time for exercise. Also, as previously discussed, more work hours may increase P. Spouse's work hours may also influence P, since families often eat together. Spouse's work hours do not impact exercise as clearly as own work hours. However, an individual could potentially increase exercise if her spouse works more, since spending less time with her spouse allows more time for exercise. Therefore,

$$P_t = P(H_t, HS_t, X_t) \tag{4}$$

$$E_t = E(H_t, HS_t, X_t) \tag{5}$$

where H = hours worked and HS = spouse's hours worked.

Combining (1), (4), and (5) yields the following structural model for adult BMI:

$$BMI_T = BMI\left[S, R, I, G, \sum_{t=0}^{T}\left(\delta^t BMI_{Ct}(P(H_t, HS_t, X_t, U_{Pt}), E(P(H_t, HS_t, X_t, U_{Et}), X_t, U_{Ot})\right)\right] \tag{6}$$

where BMI_C is change in BMI, which is a function of the aforementioned variables plus unobservable personal and societal characteristics U_P, U_E, and U_O.

(for an example, see Rashad, 2006). BMI may rise as number of children increases, since additional children place a constraint on time similar to that caused by additional work hours. Also, if a person is sick or injured, her level of physical activity may fall, increasing BMI. Finally, pregnancies increase the BMI of women.

I next convert (6) to a reduced-form model by substituting for P and E:

$$BMI_T = BMI\left[S, R, I, G, \sum_{t=0}^{T}\left(\delta^t BMI_{Ct}(H_t, HS_t, X_t, U_t)\right)\right] \tag{7}$$

where U captures all unobservable determinants of BMI changes.

In this paper, I estimate both the structural and reduced-form models. The structural model is more informative, but relies on the assumption that work hours influence weight only by affecting exercise and the percentage of meals prepared away from home, which may not be valid. First, additional work hours create additional income, which may reduce weight, although previous estimates of the effect of income on weight suggest that this effect would be small.[4] More importantly, working more may leave less time for eating, causing weight to fall. Also, working creates stress, which can lead to overeating and weight gain (Greeno and Wing, 1994). The reduced-form model does not specify the way in which work hours affect weight, meaning that I allow all of these factors to have an impact.[5]

Developing a testable structural model for the effect of parent work hours on child body weight is difficult since this effect occurs through different channels than that on adult weight. While substitution to food prepared outside the home should affect child as well as adult weight, much of the effect on children is likely the result of changes in time spent with parental supervision. Older children may be left unsupervised, and they may make less healthy eating and exercise decisions than if their choices were monitored. Parents are less likely to leave younger children alone, but baby-sitters and day-care workers may not value the long-term health of a child as much as the child's parent. The NLSYCS does not include data on child supervision. Therefore, for children, I only estimate reduced-form models similar to (7).

[4] For example, Chou, Grossman, and Saffer's (2004) results imply that, at the sample mean, a 10% increase in income would decrease BMI by 0.1%.

[5] Since I include hourly rate of pay as a control instead of income, the reduced-form model allows part of the effect of work hours on weight to occur through changes in income.

4 Data

For regressions of adult body weight, I use data from the 1979 cohort of the National Longitudinal Survey of Youth. The NLSY includes data from 6,111 randomly-chosen U.S. youths, plus a supplemental sample of 5,295 minority and economically disadvantaged youths and 1,280 military youths. The NLSY first conducted interviews in 1979, and all respondents were between fourteen and twenty-two years of age at this time. Subsequent interviews occurred each year until 1994, and then every two years until 2004. The respondents' reported their weight in 1981, 1982, 1985, 1986, 1988, 1989, 1990, 1992, 1993, 1994, 1996, 1998, 2000, 2002, and 2004 and their height in 1981, 1982, and 1985. In order to ensure that my sample consists entirely of adults, I include only the years 1985-2004. Given the age of respondents, I assume height in 1985 to be adult height and use it as height for all years. Although the retention rate of the NLSY79 was high, not all youths were followed for the duration of the sample; therefore, my data are an unbalanced panel. Eliminating observations with missing data leaves me with a total of 10,194 individuals and 85,759 observations. Table 1 reports summary statistics for variables used in the adult regressions.

I obtained data on children from the NLSY79CS, which features interviews with children of mothers found in the NLSY79. Children's height and weight were only recorded in even-numbered years from 1986-2004; therefore, these are the years included in my sample. Following the approach of ABL, I drop children under the age of 3. I also eliminate those over 17 since such young adults are less likely to live with their parents. Table 2 summarizes the data taken from the NLSYCS. Other variables used in regressions of children's weight are information about the child's mother matched from the NLSY.[6] After eliminating observations with missing data, my sample size for children's regressions is 33,652 observations (8,611 children).

The first dependent variable in my adult regressions is body mass index, which is equal to

[6]Since the NLSY generally interviewed mothers and their children at the same time, virtually all children in the NLSYCS lived with their mothers. Therefore, modeling their weight as a function of their mother's attributes should be reasonable.

weight in pounds divided by height in inches squared, multiplied by 703. Following convention in the literature, I also use a binary variable for whether or not the individual is obese. The average BMI in the sample is 26.0, while the obesity rate is 17.9%. Using BMI for children is inappropriate since the medically optimal BMI is different for children and young adults of different ages. For example, a 10-year-old boy is overweight if his BMI is above 22, while a 15-year-old boy would not be overweight until his BMI reached 27. Therefore, for regressions of child weight, my dependent variable is whether or not the child is overweight, which I construct using age- and gender-specific CDC growth charts.[7] Again, with children, the terms "overweight" and "obese" are used interchangeably. 14.7% of the sample is overweight/obese. My independent variables of interest are the person's (child's mother in children's regressions) average hours worked per week since the last interview and spouse's average hours worked per week in the past year, in units of 10. The sample means for hours and spouse's work hours are 3.4 and 2.2, respectively. The mean for spouse's work hours is smaller because I impute values of zero for single people.

For structural models of adults' weight, I construct an estimate of exercise frequency using two survey questions. In 1998 and 2000, the NLSY asked the respondents the frequency with which they obtained both light exercise, such as walking, and strenuous exercise, such as working out or participating in sports. For both questions, the respondents chose from the following options: never, less than once a month, one to three times a month, once or twice a week, and three or more times a week. Using this information, I formed estimates of the individuals' number of times exercising, both light and heavy, per week. If a person answered "never," I assigned her a value of 0. Someone who answered "less than once a month" was assigned a value of 1/8 time exercising per week (1/2 per month), while one to three times a month was assigned 1/2 per week (2 per month), one to two times a week was assigned 1.5

[7] Self-reported weight and height could be problematic as people commonly underreport their weight and, to a lesser extent, overreport their height. However, researchers with access to both self-reported and actual weight and height have shown that, in regressions of body weight, correcting for errors in the self-reported values does not substantially alter coefficient estimates (for examples, see Cawley (1999) and Lakdawalla and Philipson (2002)). In other words, the extent to which one underreports weight or overreports height does not appear to be correlated with the variables commonly included in body weight regressions.

per week, and three or more times a week was assigned 4 per week. I then added light and heavy exercise to determine total exercise.[8] Using this approach, the average individual in my sample exercised 3.8 times per week.

Due to data limitations, I use proportion of total food expenses spent on restaurants as a proxy for percentage of meals prepared away from the home. In the 1990-1994 surveys, the NLSY asked respondents to estimate their total food expenditures as well as the amount spent at restaurants and on food delivery. Adding the amounts spent at restaurants and on delivery, then dividing this sum by total food expenditures, yields the proportion of food expenses spent on food prepared by restaurants. For the average respondent, this number was 26%.

In some regressions, I also group hours worked by occupation type: blue collar, white collar, or service. I consider an individual to be "blue collar" if her primary occupation is classified as "craftsman, foremen, and kindred;" "armed forces;" "operatives and kindred;" "laborers, except farm;" "farmers and farm managers;" or "farm laborers and foremen." I label an individual "white collar" if her occupation is "professional, technical, and kindred;" "managers, officials, and proprietors;" "sales workers;" or "clerical and kindred" and "service" if her occupation is "service workers, except private household" or "private household."

The wide range of questions asked by the NLSY survey allows me to include the other factors discussed in section 3 that could be expected to influence adult weight: race, gender, intelligence (score on the Armed Forces Qualifying Test), hourly rate of pay, highest grade completed, marital status, age, number of children, whether or not the respondent has any health conditions that limit the amount or type of work she can perform, and whether or not the respondent is pregnant.[9]

[8] One might expect heavy exercise to reduce weight more than light exercise. However, strenuous exercise such as weightlifting builds muscle mass in addition to burning fat, so theoretically heavy exercise may actually have a smaller overall impact on weight. Since I am uncertain about the relative impact of the two types of exercise, I weight them equally.

[9] I construct hourly rate of pay for the household by dividing total household income by the sum of own and spouse's work hours (which are zero if the person is single). I set rate of pay to zero for households where neither the respondent nor her spouse worked at all during the preceding year; this affects a very small percentage of households.

For children's weight, I include these same characteristics (except for pregnancy status) as well as birth order and indicator variables for whether or not the child's mother is overweight or obese. I add these variables to mirror the approach used by ABL.

5 Reduced-Form Adults

5.1 Models

I begin by estimating the reduced-form model (7). The reduced-form approach captures the overall effect of work hours on weight, which may occur through several channels, whereas the structural model forces this effect to occur only through exercise and the percentage of food prepared by restaurants. The discussion in section 3 highlights the importance of accounting for past values, in addition to current values, of the independent variables. In their studies of the effect of maternal employment on child weight, ABL and Ruhm (2004) accomplish this by converting the key independent variables to averages of their values over the child's entire life. Since I focus on adults, whom I do not observe from birth, I apply a variation of their approach by averaging over the individual's entire adult life, which I define as being at least 23 years old.[10] Assuming a linear functional form, I begin by estimating the following random effects model with generalized least squares:[11]

$$W_{it} = \beta_0 + \beta_1 aH_{it} + \beta_2 aHS_{it} + \beta_3 AGE_{it} + \beta_4 X_{1it} + \beta_5 aX_{2it} + T_t + \omega_i + \varepsilon_{it} \tag{8}$$

where W_{it} is a measure of weight (BMI or obesity status)[12] for individual i in period t, H is average weekly work hours in units of 10, HS is spouse's average weekly work hours in units

[10] I use age 23 instead of 18 because individuals in the 18-22 age group are likely to be college students. Students may work a large number of hours, but the NLSY work hour statistics do not reflect unpaid work, such as studying.

[11] In order to estimate a random effects model with sampling weights, I use the Stata module "xtregre2" by Merryman (2005).

[12] I estimate linear probability models (LPMs) when obesity status is the dependent variable. In the children's section, this makes my results comparable to those of ABL, who also used LPMs. All results are robust to the use of probit and logit models.

of 10, X_1 is a set of time-invariant controls (race, gender, and intelligence), X_2 is a set of controls (other than age) that vary over time (marital status, health limitations, hourly rate of pay, education, number of children, and whether or not the person is pregnant), T is a year fixed effect, and ω is the random effect. Also, a indicates average, which I define as

$$aZ_{it} = \frac{\sum_{j=1}^{t} Z_{ij} * WK_{ij}}{\sum_{j=1}^{t} WK_{ij}} \tag{9}$$

where $Z = H$, HS, or X_2 and WK_{ij} is the number of weeks since the respondent's last interview (or 52 for the first interview). I do not average age, pregnancy status, the time-invariant characteristics in X_1, and the time dummies. β_1 measures the effect of an additional ten work hours per week over the individual's entire adult life on BMI or P(Obese), while β_2 measures the effect of one's spouse working an additional ten hours. I set spouse's work hours equal to 0 if the person is single. By controlling for marital status, I differentiate between the effect on single people and married people whose spouses do not work.

In the random effects model, $\widehat{\beta}_1$ and $\widehat{\beta}_2$ are consistent only if the individual effect α_i is uncorrelated with work hours and spouse's work hours, an assumption that may not be valid. For example, people who are ambitious may both work a large number of hours and maintain a healthy weight, biasing $\widehat{\beta}_1$ downward. Since people tend to choose spouses who are similar to themselves, the estimates of β_2 could also suffer from bias. Additionally, hard-working, financially successful individuals may marry thin spouses, in which case $\widehat{\beta}_2$ may be biased downward.

To account for sources of endogeneity that are constant over time, ABL use a "long differences" approach in which they difference between the child's last and first years in the sample.[13] Because they used children in the age range 3-11, the differences for most children were over an eight-year period. Since weight likely responds gradually to changes in work

[13]Since the independent variables of interest are averages over the child's life, differences reflect changes in the variable averages over time.

hours, such an approach may be more appropriate than first differences or fixed effects. ABL also argue that long differencing reduces the extent of bias from measurement error.

In order to apply a similar estimation technique to adults, I difference between the current year and eight years ago. Since most adults are in the sample for twenty years, differencing between the last and first years may be excessive in accounting for the gradual nature of weight changes. Also, by allowing each individual to be in the sample more than once, I retain the degrees of freedom and extra information from the additional observations.[14] I restrict the sample to observations where the person was at least 28 years old in the initial period. This ensures that the averages in each initial period are based on at least five years' worth of data, and therefore not driven by one atypical year.[15]

My long difference regression equation is:

$$\Delta W_{it} = \beta_0 + \beta_1 \Delta a H_{it} + \beta_2 \Delta a HS_{it} + \beta_3 \Delta AGE_{it} + \beta_4 \Delta a X_{2it} + \Delta T_t + \Delta \varepsilon_{it} \qquad (10)$$

where Δ represents difference. $\widehat{\beta}_1$ and $\widehat{\beta}_2$ now provide consistent estimates under the assumption that changes in work hours are uncorrelated with changes in the error term. While I cannot be completely certain of the validity of this assumption, the most likely sources of bias, such as ambition, are relatively stable over time. Also, failure to account for changes in ambition over time should bias my estimates downward, in which case my results are a lower bound.[16] Furthermore, ABL employed both long differences and instrumental variable approaches, and obtained similar results with each, suggesting that differencing produces a consistent estimate of the effect of maternal work hours on child weight. Nonetheless, I cannot be sure that these findings would be similar with adult weight.

(8) and (10) both assume that the effect of one's work hours on weight is the same for

[14] In regressions not reported in this paper, I difference between the last and first years and obtain very similar results.

[15] Results are robust to starting at a different age.

[16] I cannot completely rule out the possibility that my estimates are biased upward. For example, people who work long hours may be those who are less concerned about their health than others and therefore weigh more.

both married and single people. However, people who are married have a spouse to assist with meal preparation; therefore, the work hour effect may be smaller for them than for singles. Alternatively, marrying often introduces a new set of responsibilities, ranging from home ownership to raising children. If married individuals face tighter time constraints than singles, marrying may exacerbate the work hour effect.

In (8) and (10), I also assume that the effect of one's work hours on weight does not depend on how much one's spouse works, and that the effect of spouse's work hours on weight does not depend on own work hours. If a person whose spouse does not work begins to work more, the spouse may be able to compensate by handling more of the food preparation duties. If the spouse also works, this becomes more difficult, suggesting that the work hour effect depends on spouse's work hours, and (analogously) that the spouse work hour effect depends on own work hours.

I next relax these assumptions by interacting work hours with marital status and spouse's work hours:

$$\begin{aligned} \Delta W_{it} &= \beta_0 + \beta_1 \Delta aH_{it} + \beta_2 \Delta aHS_{it} + \beta_3 \Delta (aHWK_{it} * aUNMARRIED_{it}) \\ &\quad + \beta_4 \Delta (aH_{it} * aHS_{it}) + \beta_5 \Delta AGE_{it} + \beta_6 \Delta aX_{2it} + \Delta T_t + \Delta \varepsilon_{it} \end{aligned} \tag{11}$$

The effect of ten additional work hours per week is $\beta_1 + \beta_3$ for singles, β_1 for married people whose spouses do not work, and $\beta_1 + 4\beta_4$ for married people whose spouses work 40 hours per week. The spouse work hour effect is β_2 for people who do not work and $\beta_2 + 4\beta_4$ for those who work 40 hours per week.

In my final reduced-form regressions for adults, I conduct additional tests of the homogeneity of the work hour and spouse's work hour effects. First, I estimate (10) separately for men and women to determine if these effects vary on the basis of gender. Next, I differentiate between the work hour effects of white collar, blue collar, and service workers using the following regression equation:

$$\Delta W_{it} = \beta_0 + \beta_1 \Delta(aH_{it} * aWHITEC_{it}) + \beta_2 \Delta(aH_{it} * aBLUEC_{it}) \quad (12)$$
$$+\beta_3 \Delta(aH_{it} * aSERVICE_{it}) + \beta_4 \Delta aHS_{it} + \beta_5 \Delta AGE_{it} + \beta_6 \Delta aX_{2it} + \Delta T_t + \Delta \varepsilon_{it}$$

where $aWHITEC$ represents the proportion of time since age 23 the respondent has held a white collar job, $aBLUEC$ represents a blue collar job, and $aSERVICE$ represents a service occupation. A finding that $\beta_3 > \beta_2$ and $\beta_1 > \beta_2$ would provide evidence that shifts in employment over time from blue collar to white collar and service professions may have increased the average work hour effect. Lastly, I differentiate between the effects of work hours on the weight of people who were overweight or obese at the beginning of the panel (1985) and those who were not by dividing the two groups into subsamples and estimating (10) for each. If working only increases the weight of people who initially were within the healthy weight range, then such a weight gain may not worsen health. Gaining weight could even improve the health of people who were initially underweight.

5.2 Results

The first half of table 3 reports the results from the reduced-form adults regressions using BMI as the dependent variable. Columns 1-3 contain the output for (8), (10), and (11), respectively. Using random effects, a ten-hour per week increase in work hours is associated with a statistically significant 0.06 unit increase in BMI. At the average sample height, one unit of BMI corresponds to 6.5 pounds, making this estimate equivalent to 0.4 pounds. Spouse's work hours do not appear to affect BMI as the point estimate is negative but small and insignificant.[17]

[17] The coefficient signs for the control variables support previous findings in the literature. If one's activity is limited by health conditions, her BMI is higher. Household wage, intelligence, and education are all negatively correlated with BMI. Married people weigh more than singles, and people gain weight as they grow older. Minorities weigh more than whites, and the BMI of women is less than that of men. Also, women gain weight when they are pregnant. Number of children is the only statistically insignificant variable. The model explains 9% of the variation in body weight.

As shown in column (2), differencing increases the estimated work hour and spouse's work hour effects substantially. A ten-hour per week increase in a person's work hours increases her BMI by 0.18 units (1.2 pounds) at the sample mean height, while a similar increase in spouse's work hours leads to a 0.1 unit rise in BMI (0.7 pounds). These results suggest that those obtained using random effects were biased downward, which is not surprising given the discussion in the preceding section.

The third column shows the regression output when I include the interaction terms $aH * aUNMARRIED$ and $aH * aHS$. The work hour effect is weaker for people who are single, implying that the effect of facing additional constraints on time after marrying outweighs the effect of having an additional person to share with the food preparation. The interaction term work hours*spouse's work hours is positive, as expected. However, neither interaction term is significant, so these findings are inconclusive. The first column of tables 4 and 5 expresses these results in a more usable form. The effect of 10 additional work hours over an individual's entire adult life is 0.4 pounds for singles, 1.3 pounds for people who are married to a spouse who does not work, and 1.8 pounds for people who are married to a spouse who works. The effect of 10 additional spouse's work hours is 0.3 pounds for people who do not work and 0.8 pounds for people who work.

The second half of table 3 reports the results using whether or not the person is obese as the dependent variable. Signs of the coefficients are similar to those using BMI. With random effects, work hours increase P(Obese) by 0.7 percentage points while spouse's work hours decrease it by 0.6 percentage points. Both variables are significant in both regressions. Applying long differences, working ten additional hours per week increases one's P(Obese) by a statistically significant 1.2 percentage points. The spouse work hour effect becomes virtually zero, suggesting that spouse's work hours may affect weight but not obesity.

The sign of the coefficient of the interaction term unmarried*work hours is again negative, while that of work hours*spouse's work hours is now negative but very small. Both are statistically insignificant. The second column of tables 4 and 5 shows that the effect of

10 additional work hours per week on the probability of becoming obese is 0.8 percentage points for singles, 2.0 percentage points for married people with non-working spouses, and 1.5 percentage points for married people with working spouses. The spouse work hour effect is 0.4 percentage points for those who do not work and -0.1 percentage points for those who do.

Table 6 shows the results for the regressions which divided the sample into women and men. Since the impact of adding the interaction terms was inconclusive, I use long differences without interaction terms. The work hour effect appears stronger for women than men when using BMI as the dependent variable, but becomes stronger for men when obesity status is used. Neither difference is statistically significant at the 5% level. For both genders, one's spouse working causes a modest increase in BMI but essentially no change in P(Obese). In short, there does not appear to be an obvious difference in how own or spouse's work hours impact the weight of the two genders.

In table 7, I report results for the regressions with work hours grouped by occupation type. The work hour effect does appear strongest for white-collar workers, but the effect on blue-collar workers is almost as large. Only service workers do not appear affected by additional work. When interpreting these findings, note that BMI does not distinguish between fat and muscle mass. It is possible that blue-collar workers, who often engage in strenuous on-the-job exercise, may actually be adding muscle instead of fat. In contrast, the jobs of service workers likely involve only low-intensity exercise, such as walking, which builds little or no muscle. If the weight gain of blue-collar workers is in fact muscle instead of fat, then my results may overstate the health consequences of additional work.

Table 8 displays the results dividing the sample into people who were overweight or obese at the beginning of the panel, whom I classify as "at risk" for obesity, and those who were not. The effects of own and spouse's work hours on the BMI of the "at risk" group are positive and large. The own work hour effect implies that an unemployed person who begins to work forty hours per week will ultimately gain almost ten pounds. However, the effects on the BMI of people who did not begin the panel overweight are small and insignificant. One possible explanation for the discrepancy is that people who place a high value on health may make a special effort to maintain healthy eating and exercise habits after their work hours rise. For example, they may still eat more fast food but choose the healthiest items on the menu. However, it is also possible that all people make less healthy decisions, but only those who are genetically prone to weight gain actually gain a noticeable amount of weight. In either case, the fact that the impact of work hours on weight is substantially stronger for people who are at risk for obesity means that the work hour effect is particularly hazardous to public health.

6 Structural Estimation

6.1 Model

I next estimate the structural model (6) to determine if work hours affect exercise and eating at restaurants, and if exercise and eating at restaurants affect weight. I employ a two-stage least-squares procedure, using work hours and spouse's work hours as instruments for exercise and percentage of food expenditures spent on restaurants. Since spouse's work hours are only non-zero for people who are married, I drop singles from the sample. My regression equations are

$$\widehat{PREST}_{it} = \gamma_0+\gamma_1 H_{it}+\gamma_2 HS_{it}+\gamma_3 AGE_{it}+\gamma_4 X_{1it}+\gamma_5 X_{2it}+\gamma_6 t + \eta_{it} \quad (13)$$

$$\widehat{EXERCISE}_{it} = \alpha_0+\alpha_1 H_{it}+\alpha_2 HS_{it}+\alpha_3 AGE_{it}+\alpha_4 X_{1it}+\alpha_5 X_{2it}+\alpha_5 t + \mu_{it} \quad (14)$$

$$W_{it} = \theta_0+\theta_1 \widehat{PREST}_{it}+\theta_2 \widehat{EXERCISE}_{it}+\theta_3 AGE_{it}+\theta_4 AGE_{it} +\theta_5 X_{1it}+\theta_6 X_{2it}+\theta_7 t + \nu_{it} \quad (15)$$

where $PREST$ is the percentage of one's family's food expenditures spent on restaurants and $EXERCISE$ is the average number of times exercising per week. In the first-stage regressions (13) and (14), I estimate the determinants of $PREST$ and $EXERCISE$. I use these predicted values in the second-stage regression (15). I elect not to employ a differences approach because it would result in the loss of half the sample for (14), inflating the standard errors to the point where H and HS become very weak instruments for $EXERCISE$.[18] In the reduced-form section, neglecting to difference biased my results downward. I therefore expect that, if anything, the results in this section are understatements.

My estimates of θ_1 and θ_2 are consistent if and only if H and HS are uncorrelated with ν, which may not be the case if the work hour effect occurs partially through other mechanisms. The second-stage estimates should therefore be interpreted with caution. However, the first-stage estimates of the effect of work hours and spouse's work hours on exercising and eating are the primary focus of this section, since the second-stage findings that exercise reduces weight and that eating at restaurants increases weight are already widely assumed.

Another limitation of the structural analysis is that $PREST$ is available in only five surveys (1990-1994), while exercise data is reported in only two (1998 and 2000). Consequently, estimating (15) with only the years used to estimate (13) and (14) results in no observations. I therefore generate predicted values for $PREST$ and $EXERCISE$ in all years of the panel using only the data from the years in which the variables are defined. The validity of this approach depends on if the relationships between the regressors in (13) and $PREST$ are the same in 1990-1994 as they are in the other survey years, and the relationships between the regressors in (14) and $EXERCISE$ are the same in 1998-2000 as they are in the other survey years.[19] I compute bootstrap standard errors in both stages.

The relationship between work hours and income creates an additional complication. Since I control for wage instead of income in (13)-(15), income is an omitted variable. Working additional hours increases income, which decreases weight, so my estimates of θ_1 and θ_2 will likely be biased toward zero. However, a variety of research shows that the effect of income on weight is small (see footnote 3), so I expect that the extent of the bias is minimal. Nonetheless,

[18] Differencing does not affect the results in (13), likely because $PREST$ exists in five survey waves, compared to only two for $EXERCISE$.

[19] Since year fixed effects cannot be used with this approach, I include a linear time trend instead. In the reduced-form analysis, using a linear time trend instead of year effects does not substantially change the results.

as a robustness check I also estimate the two-stage least-squares model including income as a control instead of wage.

6.2 Results

Table 9 shows the results for the first stage of the two-stage least-squares analysis. The first two columns estimate the determinants of the percentage of household food expenditures spent on food prepared at restaurants, while the third and fourth columns estimate the determinants of exercise frequency. Columns labeled (1) include wage as a control, while those labeled (2) include income. As expected, the two sets of results are very similar. A ten-hour per week increase in work hours increases the proportion of food prepared at restaurants by a statistically significant 0.9-1.0 percentage points (4%), and the spouse work hour effect is virtually identical.[20]

As expected, additional work hours decrease exercise. A ten-hour per week increase is associated with a statistically significant 0.10-0.11 fewer times exercising per week (3%).[21] Interestingly, spouse's work hours are positively correlated with exercise. While the effect is small, it is significant at the 10% level. One possible explanation for this result is that, if one spends less time with one's spouse, more time becomes available for other activities, such as exercising.[22]

Table 10 reports the results for the second stage. The predicted values of percentage of food prepared by restaurants and exercise have the expected effect on BMI and P(Obese). A 10 percentage point, or 40%, increase in proportion of food prepared by restaurants increases BMI by 0.26-0.32 units and P(Obese) by 2.5-3.4 percentage points (14-19%). Exercising one additional time per week is associated with a 0.8 unit reduction in BMI and 5.4-5.5 percentage

[20]Health limitations, age, number of children, intelligence, and being pregnant are negatively associated with this proportion, while household wage and education are positively associated with it.

[21]Results are almost identical using a Tobit model left-censored at 0, as less than 5% of the sample reports never exercising.

[22]Health limitations appear to decrease exercise, while education and intelligence increase it. The effects of wage, age, number of children, and pregnancy status are inconclusive. Blacks exercise less than whites, while women exercise less than men.

point drop in P(Obese) (30%). Both exercise and percentage of food prepared at restaurants are statistically significant.

Tables 11 and 12 combine the first and second stages to determine the overall effect of work hours on weight. Working an additional ten hours per week increases BMI by 0.11-0.12 units (0.7-0.8 pounds) and P(Obese) by 0.8-0.9 percentage points. The effect of spouse's work hours is essentially zero. These magnitudes are similar to those obtained using pooled OLS reduced-form estimation. Approximately 30% of this work hour effect occurs through a substitution away from food prepared at home to food prepared at restaurants, while the other 70% occurs through reducing exercise. Spouse's work hours do not appear to affect weight: the food substitution effect is offset by the increase in exercise. As expected, the effects of work hours on weight are slightly larger when I control for income instead of wage.

7 Reduced-Form Children

7.1 Models

I next analyze the effect of parents' work hours on the weight of children and young adults. I employ only reduced-form models since, as shown by Fertin et al (2006), much of the effect of work hours on child weight occurs through changes in supervision, which I do not observe in the data. My estimation approach for children is virtually identical to that of ABL, except for three main changes. First, they only utilize up to the 1996 NLSY wave, so my data set includes an additional four periods. Second, I include mother's spouse's work hours as a regressor in addition to mother's work hours. Third, my sample consists of all children and young adults between the ages of 3 and 17, whereas their sample excludes those over 11.

I begin with a random effects linear probability model with the independent variables converted to averages over the child's entire life, using whether or not the child is overweight

(O) as the dependent variable:

$$O_{it} = \beta_0 + \beta_1 aH_{it} + \beta_2 aHS_{it} + \beta_3 aAGE_{it} + \beta_4 aCHAGE_{it} + \beta_5 X_{1it} + \beta_6 aX_{2it} + \omega_i + T_t + \varepsilon_{it} \quad (16)$$

where AGE is the child's mother's age, while $CHAGE$ is the child's age. X_1 again represents the set of time-invariant characteristics, which in this case are mother's intelligence and child's race, gender, and birth order. X_2 is the set of characteristics that vary over time: mother's household wage, education, marital status, overweight status, and obesity status and the total number of children under the age of 18 living in the child's home. I again construct independent variable averages according to equation (9).

I next implement a long differences approach, using the child's first observation after turning three as the "initial period," and her last observation before turning eighteen as the "final period." Few children are in the sample from birth to the age of eighteen; the average length of time between initial and final periods is seven years. Next, I include the interaction terms $H * UNMARRIED$ and $H * HS$. Finally, I conduct separate regressions for boys and girls to determine if the work hour effect differs on the basis of the child's gender.

7.2 Results

In table 13, I report the results from the regressions of children's probability of being overweight. Columns (1) to (3) show regression output from estimating the random effects model, the long differences model, and the long differences model with the interaction terms, respectively. In the first column, ten additional mother's work hours per week over the course of the child's life are associated with a 0.8 percentage point increase in P(Overweight), but the effect of spouse's work hours is practically zero.[23] Long differencing doubles the mother's work hour effect, but the spouse work hour effect remains essentially zero.

[23] Mother's education and intelligence and the number of children in the household are negatively correlated with children's P(Overweight). P(Overweight) rises if the child is black or the mother is older, overweight, or obese. Female children are less likely to be overweight than male children. The other variables are not statistically significant.

Column 3 shows that the work hour effect is slightly stronger for children of unmarried mothers, and slightly weaker for children of married mothers whose spouses work. Both interaction terms are insignificant. Tables 14 and 15 offer a more useful display of these results. The impact of a mother working an additional 10 hours per week on her child's P(Overweight) is 2.5 percentage points for single mothers, 1.8 percentage points for married mothers whose husbands do not work, and 1.4 percentage points for married mothers whose husbands work. If a mother's spouse works an additional 10 hours per week, her child's P(Overweight) rises by 0.3 percentage points if the mother works and falls by 0.1 percentage points if she does not.

Table 16 displays the coefficients of interest for the regressions where I divide the sample into girls and boys. The results are very similar for the two genders.

8 Economic Significance

I next examine the economic significance of these results by attempting to answer two questions. First, what would be the effect of a ten-hour-per-week increase in all adults' work hours on the prevalence of obesity and overweight children, mortality, and medical expenditures? Second, what percentage of the increase in adult obesity and overweight children over the past half-century can be explained by observed changes in the employment patterns of men and women?

In Appendix A, I describe in detail the method used to determine the answers to these questions, and discuss possible caveats. I estimate that a ten-hour-per-week increase in the average adult's work hours would increase obesity by 3.7%, leading to 4,144 deaths and $4.33 billion in additional medical expenses per year. Adding ten hours to the work week for women would increase childhood obesity by 11.1%. However, a similar increase in men's work hours would only increase childhood obesity by 0.6%. As displayed in table 16, observed changes in employment patterns explain 6.2% of the rise in adult obesity during the period 1961 to 2004 and 10.4% of the rise in overweight children between 1968 and 2001.

9 Conclusion

In this paper, I analyze the effect of adult work hours on the weight of both adults and children. I find that adults who increase work hours exercise less and substitute from food prepared at home to food prepared at restaurants, both of which lead to weight gain. An increase in a person's work hours leads to a smaller weight gain for her spouse; the food substitution effect appears to be offset by a slight rise in the spouse's exercise. I also show that, if a mother works more, the probability that her children and young adults are overweight rises. However, mother's spouse's work hours do not affect the weight of children, suggesting that mothers pay more attention to the eating and exercise habits of their children than fathers. In the past half-century, female employment in the U.S. has risen while male employment has fallen by a lesser amount. I estimate that these changing employment patters account for 6% of the rise in adult obesity between 1961 and 2004 and 10% of the increase in overweight children from 1968 to 2001. While these calculations are crude in that I extrapolate results obtained from 1985-2004 data to a longer time period, they suggest that the contribution of the increase in labor force participation to America's rise in obesity has been nontrivial.

Anecdotal evidence suggests that many Americans are working longer hours than ever, and that employees in some professions routinely work sixty to eighty hours per week or more. My results also imply that such long work weeks could have a detrimental effect on health by leading to a higher probability of becoming obese.

The results of this study should not be interpreted to mean that the increase in women's labor force participation has harmed society, or that women today should reduce their work hours. The expansion of women's rights that contributed to this rise in female employment was obviously one of the great advancements of the 20th Century. My findings instead indicate that people who work long hours should realize the potential health consequences and take steps to prevent them from occurring. Government information-spreading programs may therefore prove useful. Another possible policy implication is that the government could subsidize "healthy" convenience food. Health bars and shakes, which require little or no preparation time, are becoming commonplace in supermarkets and even convenience stores. However, they remain expensive compared to less-healthy snack foods. Additionally, the government could use tax incentives to encourage fast-food restaurants to serve a wider variety of healthy items. Finally, tax incentives for companies to provide on-the-job exercise facilities would limit the time costs associated with exercise and possibly mitigate the work hour effect. Future research is necessary to determine if any of these policies would improve social welfare.

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Appendix A – Economic Significance Calculations

A.1 Adults

In this section, I assess the economic significance of my results by estimating the impact of a ten-hour per week per adult increase in work hours on adult obesity, as well as the percentage of the recent rise in adult obesity that can be explained by changing employment patterns.

Since the results in table 6, where I split the sample into women and men, are inconclusive, in this section I assume that the work hour effect and spouse work hour effect are the same for both genders. Additionally, since I was unable to reach a definitive conclusion about whether or not the work hour effect is different for singles and married people, I assume that the work hour effect does not depend on marital status. Finally, since I found that the work hour effect was similar for married people whose spouses work and those whose spouses do not work, I assume the same effect for the two groups. Therefore, I calibrate the equations in this section using the results from column (3) in table 3, in which I estimated that ten work hours per week increases P(Obese) by 0.012 percentage points, and that ten spouse work hours decreases P(Obese) by 0.0002 percentage points.

The overall effect of an increase in women's work hours on obesity is equal to its effect on women plus its effect on men. The derivative of the obesity rate with respect to women's work hours is therefore:

$$\frac{dO}{dH_W} = P_W \frac{dO}{dH} + P_M M_M \frac{dO}{dHS} \tag{17}$$

where O is the obesity rate, H_W is the average hours worked per week for women, P_W is the proportion of the adult population that is female, P_M is the proportion of the adult population that is male, M_M is the proportion of adult men who are married, and dO/dH and dO/dHS are the derivatives of the obesity rate with respect to own work hours and spouse's work hours. Similarly, the change in obesity with respect to a change in men's work hours is:

$$\frac{dO}{dH_M} = P_M \frac{dO}{dH} + P_W M_W \frac{dO}{dHS} \tag{18}$$

(17) and (18) reduce to:

$$\frac{dO}{dH} = \frac{dO}{dH} + M \frac{dO}{dHS} \tag{19}$$

where H is average hours worked by all adults and M is the proportion of the adult population that is married. After calibrating (19) using the estimates from this paper along with the marriage rate from the 2000 census, it becomes:

$$\frac{dO}{dH} = 0.012 + 0.54(-0.0002) = 0.0119$$

Dividing this result by the 2004 obesity rate of 0.322 shows that a ten-hour-per-week increase in the average adult's weekly hours worked would increase the obesity rate by 3.7%. Using the estimated costs of obesity from the introduction, these numbers translate to 4,144 deaths and \$4.33 billion in medical expenditures per year.

I next estimate the percentage of the increases in adult obesity (from 1961-2004) that can be explained by changes in work hours during the periods.[24] The proportion of adults who are obese because of women's work hours (O_{HW}) in period t is simply dO/dH_W multiplied by the average hours worked by women in t:

$$O_{HWt} = H_{Wt}\frac{dO}{dH_W} \tag{20}$$

I approximate average weekly work hours for adult women using the percentage of single and married women employed part- and full-time combined with the average work hours for part- and full-time workers:

$$H_{Wt} = W_{St}(SW_{Ft}H_F + SW_{Pt}H_P) + W_{Mt}(MW_{Ft}H_F + MW_{Pt}H_P) \tag{21}$$

where t is 1961 or 2004, W_S is the proportion of women who are single, SW_F is the proportion of single women who are employed full time, H_F is the average weekly work hours (in units of 10) for full-time employees, SW_P is the proportion of single women who are employed part time, H_P is the average weekly work hours for part-time employees, and married (M) replaces single in the second half of the expression. Combining (17), (20), and (21), I obtain:

$$O_{HWt} = [W_{St}(SW_{Ft}H_F + SW_{Pt}H_P) + W_{Mt}(MW_{Ft}H_F + MW_{Pt}H_P)]\left[P_W\frac{dO}{dH}+P_M M_M\frac{dO}{dHS}\right] \tag{22}$$

The equation for men is analogous. Calibrating the parameters using data from the Current Population Survey yields the following set of equations:[25]

$$\begin{aligned}
O_{HW,1961} &= [(0.34)(0.34*4.48+0.11*2.15)+0.66(0.23*4.48+0.08*2.15)]\,[0.53*0.012+0.47*0.69*\text{-}0.0002] \\
&= 0.009 \\
O_{HM,1961} &= [(0.31)(0.49*4.48+0.04*2.15)+0.69(0.83*4.48+0.07*2.15)]\,[0.47*0.012+0.53*0.66*\text{-}0.0002] \\
&= 0.019 \\
O_{HW,2004} &= [(0.49)(0.40*4.48+0.14*2.15)+0.51(0.43*4.48+0.15*2.15)]\,[0.52*0.012+0.48*0.56*\text{-}0.0002] \\
&= 0.023 \\
O_{HW,1961} &= [(0.44)(0.55*4.48+0.07*2.15)+0.56(0.67*4.48+0.08*2.15)]\,[0.48*0.012+0.52*0.51*\text{-}0.0002] \\
&= 0.017
\end{aligned}$$

Between 1960 and 2004, the adult obesity rate rose by 19.4 percentage points. The percentages of this rise explained by changes in female and male employment patterns are:

$$\frac{O_{HW,2004} - O_{HW,1961}}{0.194} * 100\% = 7.2\% \text{ and } \frac{O_{HM,2004} - O_{HM,1961}}{0.194} * 100\% = -1.0\%$$

Therefore, the rise in female employment accounted for 7.2% in the rise in adult obesity

[24] The initial period was actually 1960-62, so I use the midpoint.

[25] 1960 marriage rates are taken from the 1960 census.

between 1961 and 2004, while the concurrent drop in male employment offset about one-seventh of this increase. In total, changes in work hours accounted for 6.2% of the rise in obesity during the period.

A.2 Children

I next conduct a similar analysis for children. Given the lack of conclusive results when adding the interaction terms and splitting the sample into girls and boys, in this section I assume that the work hour effect is the same for girls and boys, as well as children of single and married mothers and children of married mothers whose husbands work and married mothers whose husbands do not work. Therefore, I calibrate the equations in this section using the results from the third column of table 12. The effect of a mother working ten hours per week on her children's P(Overweight) is 0.016, while the effect for the mother's spouse is 0.001.

The following equation expresses the change in the percentage of children who are overweight if women's work hours increase by ten per week:

$$\frac{dO_C}{dH_W} = P_{CW}\frac{dO_C}{dH} \tag{23}$$

where O_C is the proportion of children who are overweight, P_{CW} is the proportion of children who live with their mothers (or another female guardian), and $dO_C/dHWK$ is the change in the "overweight rate" of children who live with their mothers with respect to a change in women's work hours. The effect of a change in men's work hours is, similarly:

$$\frac{dO_C}{dH_M} = P_{CM}\frac{dO_C}{dHS} \tag{24}$$

where $dO_C/dHSP$ is the mother's spouse work hour effect. Calibrating (23) and (24), again using data from the 2000 census, yields:

$$\frac{dO_C}{dH_W} = 0.95(0.016) = 0.015 \text{ and } \frac{dO_C}{dH_M} = 0.76(0.001) = 0.00008$$

Dividing by the 0.135 rate of overweight children, I find that a 10 hour rise in the average woman's work hours increases the prevalence of overweight children by 11.1%, while such a rise in men's hours increases it by only 0.06%.

I next estimate the percentage of the rise in overweight children from 1968-2001 that can be explained by changes in adult work hours.[26] The proportion of children who are overweight because of maternal employment (O_{CHW}) in period t is:

$$O_{CHWt} = H_{WCt}\frac{dO_C}{dH_W} \tag{25}$$

where HWK_{WC} is the average weekly hours worked by women who live with children.

$$H_{WCt} = WC_{St}(SW_{Ft}H_F + SW_{Pt}H_P) + WC_{Mt}(MW_{Ft}H_F + MW_{Pt}H_P) \tag{26}$$

[26] The initial period was 1963-1970, so I use the midpoint of that range.

where WC_S is the proportion of women with children who are single and WC_M is the proportion who are married. Combining (23), (25), and (26) yields:

$$O_{CHWt} = [WC_{St}(SW_{Ft}H_F + SW_{Pt}H_P) + WC_{Mt}(MW_{Ft}H_F + MW_{Pt}H_P)]\, P_{CW}\frac{dO_C}{dH} \quad (27)$$

The equation for men is analogous. I calibrate (27) using data from the Current Population Survey:

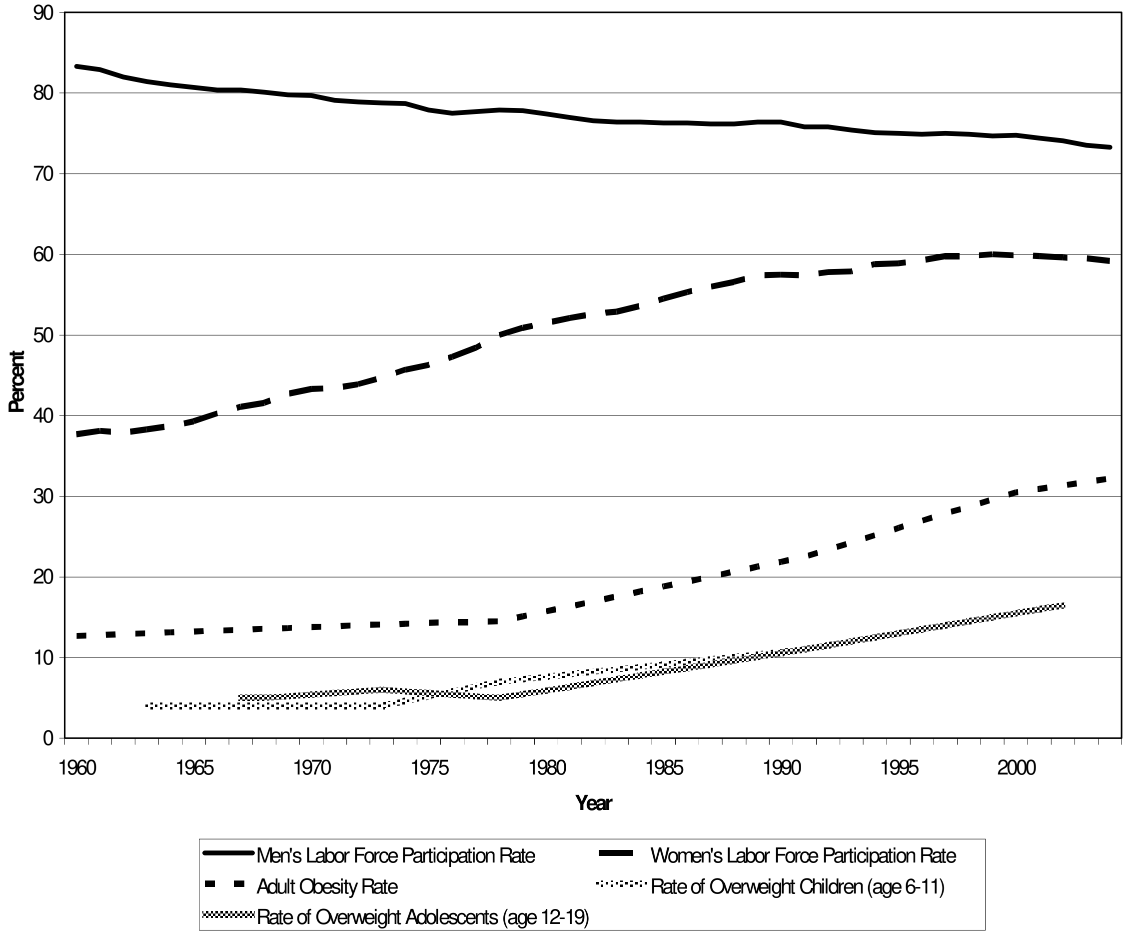
$$\begin{aligned}
O_{CHW,1968} &= [0.11(0.36*4.48+0.12*2.15)+0.89(0.26*4.48+0.09*2.15)]*0.99*0.016 = 0.022\\
O_{CHM,1968} &= [0.01(0.48*4.48+0.04*2.15)+0.99(0.81*4.48+0.07*2.15)]*0.89*0.001 = 0.003\\
O_{CHW,2001} &= [0.26(0.41*4.48+0.14*2.15)+0.74(0.45*4.48+0.15*2.15)]*0.95*0.016 = 0.035\\
O_{CHM,2001} &= [0.26(0.41*4.48+0.14*2.15)+0.74(0.45*4.48+0.15*2.15)]*0.95*0.001 = 0.002
\end{aligned}$$

The proportion of children who are overweight rose by 11.5 percentage points between 1968 and 2001. The percentages of this increase that can be explained by changes in female and male employment are:

$$\frac{O_{CHW,2001} - O_{CHW,1968}}{0.115} = 11.3\% \text{ and } \frac{O_{CHM,2001} - O_{CHM,1968}}{0.115} = -0.9\%$$

Limitations in the data force me to make three potentially problematic assumptions in the calculations in table 18. First, I assume that average hours worked per week for both full- and part-time workers are constant over time. Popular consensus is that the work week has lengthened; this would mean my results understate the true effect. Also, I assume that people work the same number of hours regardless of whether or not they have children. Since having children often causes one or both parents to reduce work hours, the change in mothers' work hours may be smaller than the change in women's work hours; therefore, my results for children may be exaggerated. Finally, I assume that the derivatives estimated in this paper are constant over time. People today have far greater access to fast food and other unhealthy pre-prepared food than they did forty years ago, suggesting that the work hour effect may be stronger today, and that the impact of changes in labor force participation in the 1960's and 1970's on body weight may have been smaller than my results suggest. On the other hand, it is possible that increased work hours induced demand for convenience food that, once created, was consumed by all. If this is the case, my derivatives understate the true effect of changing labor markets on obesity. Because of these limitations, the results in table 18 should be viewed as rough estimates and not exact calculations. Nonetheless, the sizeable magnitudes suggest that the contribution of rising work hours to America's growing obesity problem has been nontrivial.

Figure 1 – Trends in Labor Force Participation, Adult Obesity, and Overweight Children



Sources: Bureau of Labor Statistics, 2007; Flegal et al, 1998; Ogden et al 2006; and Hedley et al, 2004. Obesity and overweight data are not reported annually; values for missing years are interpolated.

Table 1 – Summary Statistics – Adults

Variable	Description	Mean (Std. Dev.)
BMI	Body mass index = weight in kilograms divided by height in meters squared	25.966 (5.381)
Obese	Binary variable that equals 1 if BMI$\geq$30 kg/m2 and 0 otherwise	0.179 (0.384)
Pct(Restaurants)	Proportion of household food expenditures spent on food eaten in restaurants or delivered	0.263 (0.191)
Exercise	Estimated number of times the respondent exercises per week	3.836 (2.596)
Work Hours	Average number of hours, in tens, worked per week since the respondent's previous interview	3.411 (1.933)
Spouse's Work Hours	Average number of hours worked per week by the respondent's spouse in the previous year set equal to 0 if the respondent is unmarried.	2.151 (2.165)
Health Limitations	Binary variable that equals 1 if amount or type of work is limited by health and 0 otherwise	0.074 (0.262)
Real Household Wage	Real (1982-84 dollars) household income divided by the sum of "Work Hours" and "Spouse's Work Hours;" set equal to 0 if this sum is 0	14.824 (71.919)
Real Household Income	Real (1982-84 dollars) household income in units of $10,000	3.574 (6.187)
Highest Grade Completed	Respondent's highest grade completed	13.388 (2.443)
AFQT Score	Score on the Armed Forces Qualifying Test, an IQ test administered to all survey participants	49.608 (28.815)
Married	Binary variable that equals 1 if the respondent is married	0.603 (0.489)
Age	Respondent's age in years	33.167 (6.063)
Number of Children	Number of children the respondent has ever had	1.358 (1.296)
Race: Black	Binary variable that equals 1 if the respondent's race is black	0.132 (0.338)
Race: Other	Binary variable that equals 1 if race is neither white nor black	0.025 (0.156)
Female	Binary variable that equals 1 if the respondent is female	0.490 (0.500)
Pregnant	Binary variable that equals 1 if the respondent is pregnant	0.063 (0.242)
White Collar	Binary variable that equals 1 if the respondent works in a "white collar" occupation	0.479 (0.500)
Blue Collar	Binary variable that equals 1 if the respondent works in a "blue collar" occupation	0.265 (0.441)
Service	Binary variable that equals 1 if the respondent works in a "service" occupation	0.106 (0.308)

Note: All summary statistics are weighted using the NLSY sampling weights.

Table 2 – Summary Statistics – Children

Variable	Description	Mean (Std. Dev.)
Overweight	Binary variable that equals 1 if the child is classified as "overweight" and 0 otherwise	0.147 (0.354)
Child's Age	Child's age in years	9.740 (4.115)
Mother's Age	Mother's age in years	35.325 (5.322)
Number of Children	Number of children under age 18 living in the household of the mother	2.423 (1.154)
Child's Race: Black	Binary variable that equals 1 if the child's race is black and 0 otherwise	0.150 (0.357)
Child's Race: Hispanic	Binary variable that equals 1 if the child's race is Hispanic and 0 otherwise	0.070 (0.255)
Child: Female	Binary variable that equals 1 if the child is female and 0 otherwise	0.487 (0.500)
Order of Birth	Respondent's order of birth to mother; 1 indicates mother's first child, etc.	1.864 (1.007)
Mother is Overweight or Obese	Binary variable equal to 1 if the child's mother is overweight of obese	0.476 (0.499)
Mother is Obese	Binary variable equal to 1 if the child's mother is obese	0.214 (0.410)

Note: All summary statistics are weighted using the NLSY sampling weights. Other variables in the children's regressions represent the mother's values of the variables in table 1.

Table 3 – Effect of Explanatory Variables on Adults' BMI/P(Obese)

	BMI			Obese		
	(1)	(2)	(3)	(1)	(2)	(3)
Work Hours (units of 10)	0.061	0.178	0.193	0.007	0.012	0.020
	(0.015)***	(0.072)**	(0.106)*	(0.001)***	(0.005)**	(0.011)*
Unmarried*Work Hours	–	–	−0.131	–	–	−0.012
			(0.137)			(0.014)
Spouse's Work Hours (units of 10)	−0.014	0.108	0.041	−0.006	−0.0002	0.004
	(0.018)	(0.059)*	(0.113)	(0.002)***	(0.006)	(0.011)
Work Hours*Spouse's Work Hours	–	–	0.021	–	–	−0.001
			(0.027)			(0.003)
Health Limitations	1.111	1.169	1.158	0.061	0.068	0.067
	(0.124)***	(0.416)***	(0.415)***	(0.012)***	(0.041)	(0.041)
Real Household Wage	−0.0003	−0.0003	−0.0003	−0.00006	−0.0006	−0.0006
	(0.0003)	(0.0004)	(0.0004)	(0.00003)*	(0.0004)	(0.0004)
Highest Grade Completed	−0.116	0.102	0.111	−0.014	0.001	0.001
	(0.022)***	(0.116)	(0.116)	(0.002)***	(0.010)	(0.010)
AFQT Score	−0.008	–	–	−0.0002	–	–
	(0.002)***			(0.0002)**		
Married	0.436	0.348	−0.094	0.031	0.054	0.012
	(0.074)***	(0.217)	(0.552)	(0.007)***	(0.024)**	(0.047)
Age	0.043	−0.064	−0.064	0.004	−0.004	−0.004
	(0.017)**	(0.054)	(0.054)	(0.001)**	(0.006)	(0.006)
Number of Children	−0.160	−0.307	−0.308	−0.003	−0.009	−0.009
	(0.028)***	(0.097)***	(0.096)***	(0.003)	(0.010)	(0.011)
Race: Black	1.488	–	–	0.085	–	–
	(0.155)***			(0.010)***		
Race: Other	0.531	–	–	0.030	–	–
	(0.306)*			(0.020)		
Female	−1.160	–	–	0.014	–	–
	(0.101)***			(0.007)*		
Pregnant	0.505	0.583	0.569	0.019	0.022	0.021
	(0.037)***	(0.105)***	(0.105)***	(0.004)***	(0.009)**	(0.009)**
Number of Observations	85,298	24,758	24,758	85,298	24,758	24,758
R^2	0.092	0.009	0.009	0.053	0.003	0.003

Notes: (1) Random effects, (2) Long differences, (3) Long differences with interaction terms, *** represents statistically significant at the 1% level; ** 5% level; * 10% level. All regressions include a series of binary variables that represent interview years; they are differenced in (2) and (3). Heteroskedasticity-robust standard errors are in parentheses. Errors in (2) and (3) are clustered by individual. Observations are weighted using the NLSY sampling weights; weights in (2) and (3) are the average from the two periods used to create the differences.

Table 4 – Effect of Working an Additional 10 Hours per Week on Adults' BMI and P(Obese)

	BMI	Obese
Person is single	0.063 (0.104)	0.008 (0.008)
Person is married; spouse does not work	0.193 (0.106)*	0.020 (0.011)*
Person is married; spouse works 40 hours per week	0.277 (0.102)***	0.015 (0.007)**

Table 5 – Effect of Spouse Working an Additional 10 Hours per Week on Adults' BMI and P(Obese)

	BMI	Obese
Person does not work	0.041 (0.113)	0.004 (0.011)
Person works 40 hours per week	0.125 (0.061)**	−0.001 (0.006)

Notes for tables 4 and 5: Standard errors are in parentheses. *** represents statistically significant at the 1% level; ** 5% level; * 10% level.

Table 6 – Effect of Work Hours Variables on the BMI and P(Obese) of Women and Men

	Women		Men	
	BMI	Obese	BMI	Obese
Work Hours (units of 10)	0.259 (0.108)**	0.005 (0.007)	0.138 (0.095)	0.017 (0.009)**
Spouse's Work Hours (units of 10)	0.083 (0.116)	0.004 (0.009)	0.081 (0.060)	−0.002 (0.008)
Number of Observations	12,510	12,510	12,248	12,248
R^2	0.014	0.018	0.006	0.003

Table 7 – Effect of Work Hours Variables on the BMI and P(Obese) of Adults – Hours Grouped by Occupation Types

	BMI	Obese
Work Hours*White Collar (units of 10)	0.158 (0.085)*	0.012 (0.005)**
Work Hours*Blue Collar (units of 10)	0.147 (0.072)**	0.009 (0.007)
Work Hours*Service (units of 10)	0.048 (0.094)	−0.002 (0.009)
Number of Observations	24,739	24,739
R^2	0.009	0.003

Table 8 – Effect of Work Hours Variables on the BMI of "At Risk" and "Not At Risk" Individuals

	At Risk	Not At Risk
Work Hours (units of 10)	0.357 (0.139)**	0.037 (0.052)
Spouse's Work Hours (units of 10)	0.189 (0.106)*	0.043 (0.058)
Number of Observations	13,351	11,407
R^2	0.010	0.015

Notes for tables 6, 7, and 8: *** represents statistically significant at the 1% level; ** 5% level; * 10% level. Both regressions are long differences averages without interaction terms. All regressions include a series of binary variables that represent interview years; these variables are differenced. Standard errors are in parentheses; all standard errors are heteroskedasticity-robust and clustered by individual. Observations are weighted using the NLSY sampling weights; weights are the average of the weights from the two periods used to create the differences.

Table 9 – Regression Output for First Stage of Instrumental Variables Analysis – Effect of Explanatory Variables on the Proportion of Food Expenses Spent on Restaurants and the Frequency of Exercise

	Pct(Restaurants)		Exercise	
	(1)	(2)	(1)	(2)
Work Hours (units of 10)	0.010 (0.001)***	0.009 (0.001)***	−0.103 (0.020)***	−0.110 (0.019)***
Spouse's Work Hours (units of 10)	0.010 (0.001)***	0.009 (0.001)***	0.050 (0.023)**	0.036 (0.023)
Health Limitations	−0.006 (0.005)	−0.007 (0.007)	−1.078 (0.114)***	−1.053 (0.100)***
Real Household Wage	0.0003 (0.0001)***	–	0.001 (0.002)	–
Real Household Income	–	0.003 (0.000)***	–	0.069 (0.010)***
Highest Grade Completed	0.005 (0.001)***	0.004 (0.001)***	0.172 (0.017)***	0.152 (0.015)***
AFQT Score	−0.0002 (0.0001)**	−0.0002 (0.0001)**	0.007 (0.002)***	0.006 (0.002)***
Age	−0.002 (0.001)***	−0.002 (0.001)***	−0.022 (0.013)*	−0.023 (0.015)
Number of Children	−0.031 (0.001)***	−0.031 (0.002)***	−0.036 (0.031)	−0.035 (0.031)
Race: Black	0.014 (0.004)***	0.014 (0.004)***	−0.415 (0.080)***	−0.401 (0.092)***
Race: Other	0.010 (0.007)	0.009 (0.006)	−0.096 (0.162)	−0.113 (0.157)
Female	−0.019 (0.004)***	−0.018 (0.004)***	−0.689 (0.098)***	−0.676 (0.088)***
Pregnant	−0.008 (0.004)*	−0.009 (0.005)*	−0.091 (0.123)	−0.111 (0.159)
Number of Observations	17,758	17,727	6,361	6,350
R^2	0.125	0.130	0.088	0.094

Notes: *** represents statistically significant at the 1% level; ** 5% level; * 10% level. Both regressions include a linear time trend. Standard errors are in parentheses; all standard errors are heteroskedasticity-robust. Observations are weighted using the NLSY sampling weights.

Table 10 – Regression Output for Second Stage of Instrumental Variables Analysis – Effect of Explanatory Variables on BMI and P(Obese)

	BMI		P(Obese)	
	(1)	(2)	(1)	(2)
Pct(Restaurants)	2.608 (0.971)***	3.178 (1.507)**	0.249 (0.073)***	0.340 (0.096)***
Exercise	−0.789 (0.120)***	−0.800 (0.153)***	−0.054 (0.009)***	−0.055 (0.010)***
Health Limitations	0.416 (0.176)**	0.429 (0.208)**	0.029 (0.014)**	0.031 (0.015)**
Real Household Wage	−0.002 (0.001)*	–	−0.0003 (0.0001)***	–
Real Household Income	–	0.015 (0.020)	–	0.0003 (0.0008)
Highest Grade Completed	−0.058 (0.026)**	−0.065 (0.031)**	−0.005 (0.002)**	−0.006 (0.002)***
AFQT Score	−0.001 (0.001)	−0.001 (0.001)	0.0002 (0.0001)	$9.47e-6$ (0.0001)
Age	0.039 (0.012)***	0.041 (0.030)	0.002 (0.001)**	0.002 (0.001)**
Number of Children	0.194 (0.043)***	0.209 (0.090)**	0.015 (0.003)***	0.017 (0.004)***
Race: Black	1.008 (0.074)***	1.003 (0.082)***	0.060 (0.006)***	0.056 (0.006)***
Race: Other	0.702 (0.096)**	0.689 (0.129)***	0.026 (0.009)***	0.024 (0.008)***
Female	−1.848 (0.087)***	−1.846 (0.097)***	−0.043 (0.006)***	−0.042 (0.006)***
Pregnant	0.448 (0.085)***	0.456 (0.098)***	0.016 (0.006)**	0.017 (0.007)***
Number of Observations	47,707	47,573	47,707	47,573
R^2	0.116	0.117	0.061	0.062

See notes for table 9.

Table 11 – Instrumental Variables Results – Effect of Work Hours on BMI

	Through Pct(Rest.)		Through Exercise		Total	
	(1)	(2)	(1)	(2)	(1)	(2)
Work Hours (units of 10)	0.026	0.029	0.081	0.088	0.107	0.117
	(0.010)***	(0.014)**	(0.020)***	(0.022)***	(0.030)***	(0.036)***
Spouse's Work Hours (units of 10)	0.026	0.029	−0.039	−0.029	−0.013	0.000
	(0.010)***	(0.014)**	(0.019)**	(0.019)	(0.029)	(0.033)

See notes for table 9.

Table 12 – Instrumental Variables Results – Effect of Work Hours on P(Obese)

	Through Pct(Rest.)		Through Exercise		Total	
	(1)	(2)	(1)	(2)	(1)	(2)
Work Hours (units of 10)	0.0025	0.0031	0.0056	0.0061	0.0081	0.0092
	(0.0008)***	(0.0009)***	(0.0014)***	(0.0015)***	(0.0022)***	(0.0024)***
Spouse's Work Hours (units of 10)	0.0025	0.0031	−0.0027	−0.0020	−0.0002	0.0011
	(0.0008)***	(0.0009)***	(0.0013)**	(0.0013)	(0.0021)	(0.0022)

See notes for table 9.

Table 13 – Effect of Explanatory Variables on Children's P(Overweight)

	(1)	(2)	(3)
Work Hours (units of 10)	0.008 (0.001)***	0.016 (0.008)**	0.018 (0.021)
Unmarried*Work Hours	–	–	0.007 (0.021)
Spouse's Work Hours (units of 10)	−0.001 (0.002)	0.001 (0.008)	0.003 (0.011)
Work Hours*Spouse's Work Hours	–	–	−0.001 (0.004)
Real Household Wage	−0.00004 (0.00007)	−0.0003 (0.0002)	−0.0003 (0.0002)
Highest Grade Completed	−0.010 (0.001)***	−0.007 (0.016)	−0.007 (0.016)
AFQT Score	−0.001 (0.000)***	–	–
Married	0.008 (0.009)	0.015 (0.040)	0.032 (0.060)
Age	−0.009 (0.001)***	−0.039 (0.035)	−0.040 (0.035)
Mother's Age	0.003 (0.001)***	–	–
Number of Children	−0.015 (0.003)***	0.008 (0.012)	0.009 (0.012)
Race: Black	0.035 (0.007)***	–	–
Race: Hispanic	0.005 (0.008)	–	–
Female	−0.012 (0.004)***	–	–
Order of Birth	0.003 (0.003)	–	–
Mother is Overweight or Obese	0.057 (0.005)***	−0.018 (0.014)	−0.018 (0.014)
Mother is Obese	0.082 (0.006)***	0.021 (0.017)	0.020 (0.017)
Number of Observations	33,652	7,261	7,261
R^2	0.049	0.007	0.007

See notes for table 3.

Table 14 – Effect of Mother Working an Additional 10 Hours Per Week on Children's P(Overweight)

	P(Overweight)
Mother is single	0.025 (0.013)*
Mother is married; spouse does not work	0.018 (0.021)
Mother is married; spouse works 40 hours per week	0.014 (0.009)

Table 15 – Effect of Mother's Spouse Working an Additional 10 Hours per Week on Children's P(Overweight)

	P(Overweight)
Mother does not work	0.003 (0.011)
Mother works 40 hours per week	−0.001 (0.012)

See notes for tables 4 and 5.

Table 16 – Effect of Work Hours Variables on the P(Overweight) of Girls and Boys

	Girls	Boys
Work Hours (units of 10)	0.016 (0.011)	0.015 (0.012)
Spouse's Work Hours (units of 10)	−0.0002 (0.011)	0.0005 (0.012)
Number of Observations	3,547	3,714
R^2	0.011	0.012

See notes for tables 6 and 7.

Table 17 – Percentage of Increases in Adult Obesity (from 1960-2004) and Overweight Children (from 1968-2001) Resulting from Changes in Work Hours

	% of Rise in Adult Obesity Explained	% of Rise in Overweight Children Explained
Changes in Women's Work Hours	7.2%	11.3%
Changes in Men's Work Hours	-1.0%	-0.9%
Changes in All Adults' Work Hours	6.2%	10.4%