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INCENTIVES IN OBESITY AND HEALTH INSURANCE

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ABSTRACT

The obesity rate in the United States has risen significantly in the past few decades. While a number of economic causes for the rise in obesity have been explored, little attention has been on the role of health insurance per se. This paper examines obesity in the context of a model where health insurance status can influence body weight. We attempt to isolate the effects of ex ante moral hazard, where people with health insurance may change their behaviors towards weight control. We use data from the Behavioral Risk Factor Surveillance System from 1993 to 2002 to determine the potential effect of having health insurance on measures of body weight. In our analyses, we control for a variety of confounding factors that may influence body weight and address the endogenous nature of health insurance. Our results show evidence that having insurance is associated with higher body mass (particularly for those above the poverty threshold) and an increased probability of being overweight. However, we find no evidence that having insurance affects the probability of being obese.

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I. Introduction

Health insurance is widely regarded as a vital input in the production of good health, but is insurance always beneficial for our health? Insurance reduces the monetary cost that individuals pay for health care, but this reduction can also lead individuals to change their behaviors. This "moral hazard" associated with health insurance can manifest itself not only by altering purchasing decisions, but also by changing other health-related behaviors. These two types of behavioral changes are termed "ex post moral hazard" and "ex ante moral hazard," respectively (Ehrlich and Becker 1972). It is this ex ante moral hazard in particular that may be bad for one's health. In the absence of insurance, individuals have strong incentives to engage in behaviors that help prevent injury and illness – for example, eating nutritious foods, exercising regularly, and avoiding risky activities. In the presence of insurance, however, the incentives to engage in health promoting behaviors are lessened as the costs incurred from being sick are lowered.

In the United States, the percentage of health care expenditures paid directly by consumers has been declining fairly consistently since the 1960s. Figure 1 shows this decline by examining the share of total personal health care expenditures paid for by different sources: consumers, private sources, and governments. Personal health expenditures include payments for hospital, physician and other professional care, nursing home and home health care, durable medical equipment, and prescription drugs. At the same time, health care costs are increasing (now estimated to be rising twice as fast as inflation) and fewer people are being covered by health insurance. Individuals who lose insurance have incentives to engage in preventative, health promoting activities, while those who have insurance and pay less out of pocket may have the opposite reaction. The research question in this paper is whether insurance status is associated with preventative health behaviors. We use the case of body weights in the United States to answer this question.

Body weight and obesity are desirable outcomes to study because weight may be plausibly affected by the availability of health insurance and the ex ante moral hazard problem. Most experts agree that body weight can be lowered with proper diet and exercise, making obesity and its associated conditions preventable by a change in behaviors not directly related to the receipt of medical care. Although the "disease" status of obesity is still debated, health insurance for the most part does not cover weight-loss treatment and only in isolated cases does it cover gastric bypass surgery, which carries with it many risks and is only recommended for the morbidly obese.[1]

One caveat to note is that relationship between obesity and insurance can be confounded by the ex post moral hazard problem if insurance coverage encourages people to visit the doctor and they receive and follow advice to lose weight (Dave and Kaestner 2006). However, the extent to which physician advice is given and followed is debatable. Some studies have shown such counseling to be effective in promoting weight loss strategies (Kant and Miner 2007; Loureiro and Nayga 2006), while others have shown physician counseling to have a minimal effect on the actual behavior of patients (Wee et al. 1999; Conway et al. 1995; Nagasawa et al. 1990; Clark 1991; Eraker et al. 1984; Ammerman et al. 1993). Patients may exhibit certain characteristics atypical of nonpatients, and physician counseling is not consistent across different demographic groups that exhibit similar ailments (Abid et al. 2005; Taira et al. 1997; Kreuter et al. 1997). To help guard against the confounding effects of doctor advice, we restrict the sample to those individuals who report no visits to a physician in the past year.

[1] In November of 2005, the Centers for Medicare & Medicaid Services proposed national Medicare coverage for bariatric surgery procedures. See the U.S. Department of Health and Human Services website at http://www.cms.hhs.gov/apps/media/press/release.asp?Counter=1733 for more details.

Obesity is defined by the National Institutes of Health as having a body mass index of 30 kg/m^2 or greater. The percentage of individuals classified as obese has risen dramatically, particularly in the 1980s. Estimates using the National Health Examination Survey show that 12.7 percent of the U.S. population aged 18 and over were obese in the early 1960s. The proportion rose slightly to 13.9 in the early 1970s and to 14.0 in the late 1970s. By the late 1980s and early 1990s, however, 21.6 percent of the population was classified as obese, and this number grew to an astounding 31.7 percent by 2004. Obesity carries many risks for a host of disorders, including heart disease, hypertension, stroke, cancer, depression, and blindness (Must et al. 1999; Mokdad et al. 2003; RNIB 2006).

Obesity is a national and global epidemic and has in its roots many potential causes. A variety of economic causes have been explored including reductions in job strenuousness (Philipson 2001; Lakdawalla and Philipson 2002), technological innovation in food processing and preparation (Cutler et al. 2003), the growing availability of restaurants (Chou et al. 2004; Rashad et al. 2006), urban sprawl (Ewing et al. 2003), and time preference for the present (Komlos et al. 2004; Smith et al. 2005; Zhang and Rashad 2008). Relatively few studies, however, have focused on the possible role of health insurance as a contributing factor to rising rates of obesity. We examine obesity in the context of a model in which status of health insurance might play a role in determining body weights.

As discussed in more detail below, the relationship between health insurance and obesity status is complicated by structural endogeneity and the potential influence of other confounding factors such as work status and income. For example, individuals with higher incomes are less likely to be obese yet more likely to have health insurance. Is it the case that these people would be even thinner had they no health insurance, as they would not discount the future heavily when they are without insurance? Or would they instead be heavier without health care, as medical services are believed to improve health outcomes? In this example, the net effect of health insurance on body weight is ambiguous. In general, existing theories regarding the production of health in the context of insurance may help guide predictions, but ultimately this is an empirical question. If health insurance has a causal negative influence on good health, then moral hazard may be a true concern. Yet if the opposite holds, this might lend further support for expanded or universal health insurance coverage due to the benefits that health insurance yields.

Using data from the Behavioral Risk Factor Surveillance System (BRFSS) from 1993 to 2002, we aim to uncover the effect that health insurance has on an individual's body weight and obesity status. We employ techniques to address the endogeneity of health insurance status. To account for variables affecting caloric intake and expenditure, which are likely to affect weight, we control for state-level variables such as fast food and food at home prices, in line with recent work by Chou et al. (2004) and Rashad et al. (2006).

II. Literature Review

The literature examining ex ante moral hazard is somewhat limited, with many of the studies examining the effects of health insurance coverage on the receipt of preventative services (Roddy et al. 1986; Lillard et al. 1986; Cherkin et al. 1990; Card et al. 2004). A few studies have examined health behaviors directly. For example, using data from the RAND Health Insurance Experiment, Newhouse (1993) examines differences in BMI, levels of physical activities, smoking, and alcohol consumption among individuals enrolled in cost sharing insurance plans and free plans. The results show no difference in these behaviors between the two groups. Kenkel (2000) also finds little evidence of a moral hazard effect in his analysis of individual behaviors using the 1990 National Health Interview Survey. His analysis suggests that people with private health insurance are more likely to engage in health promoting behaviors than those without insurance, with the one exception that men with health insurance are more likely to be obese. Kenkel states that his results may be biased if omitted factors jointly determine insurance status and health practices.

Courbage and Coulon (2004) examine the ex ante moral hazard question using data from the 2000/2001 wave of the British Household Panel Survey. Their outcomes of interest include smoking and frequency of exercising which is defined as walking, swimming, or playing sports. Insurance in the U.K. is provided nationally to all residents; however, a secondary market exists where residents buy private insurance to avoid the waiting lists prevalent in the national insurance market. The authors use the purchase of this secondary insurance as their test of ex ante moral hazard. Using probits and an instrumental variables strategy, the authors find that having secondary insurance does not reduce preventative efforts and in fact may increase them. However, given that all residents are covered by the national insurance, these results are not surprising. Their analysis essentially tests the speed of receiving care, not the presence of or generosity of insurance.

Card et al. (2004) take a unique approach to examining the relationship between health behaviors and insurance by looking at smoking, exercise, and obesity among the near-elderly and the elderly. Eligibility for Medicare at age 65 is used as an exogenous measure of insurance coverage. Using data from the 1999-2002 BRFSS surveys, they find that, in general, these health behaviors do not change with Medicare eligibility. They do, however, show that being age 65 or older is associated with a rise in the probability of being overweight or obese among blacks and low-educated minorities. Such a result is consistent with the ex ante moral hazard problem, but is not consistent with the authors' supposition that increased access to medical care will reduce poor health habits as doctors dispense advice on the health consequences of the behaviors. The authors dismiss the positive coefficients as a product of misspecification or sampling error as the results seem to be driven by a downward dip in obesity just prior to age 65.

Battacharya and Sood (2007) address the obesity externality by looking at the current scenario where health insurance is not risk rated for obesity, showing that coverage would therefore shield people from the full costs of an unhealthy lifestyle. They estimate the welfare cost of obesity using the 1998 Medical Expenditure Panel Survey and the 1997 National Health Interview Survey. Excluding the uninsured, who they presume do not face the obesity externality, they estimate the increase in medical expenditures for insured persons shifting from their optimal weights and compare this value with predetermined costs for the uninsured. The authors suggest increasing the coinsurance rate, and also hint at subsidizing a healthy lifestyle by reducing the welfare loss through technological change that decreases the costs of engaging in a healthy lifestyle.

Our paper adds to this current literature by examining the potential for ex ante moral hazard using recent data for non-elderly adults. While the randomized nature of the RAND study conducted by Newhouse (1993) may be the ideal sample design, those data were collected before the large rise in body weights seen today and the results may no longer be applicable. Kenkel (2000) is worried about endogeneity in his study, and we address this below. Card et al. (2004) examine the behavior of the near-elderly and elderly. We focus on non-elderly adults. Our results confirm that of Kenkel (2000) and Card et al. (2004) and show that having health insurance is associated with higher body weights, although there is no association with the probability of being obese. Results are more robust for those above the poverty threshold.

III. Methodology

Zweifel and Manning (2000) describe a model for ex ante moral hazard and discuss the determinants of the optimal amount of preventive effort exerted by an individual. This effort is determined by the probability of illness, the monetary loss from illness, labor supply, wages, health insurance coverage, sick pay, and insurance premiums. The benefit of engaging in prevention efforts is the decreased probability of suffering losses from illness, while the costs of prevention efforts are the opportunity costs of engaging in prevention. In this model, prevention is measured in time units and monetary costs of these efforts are ignored. However, such monetary costs would be included in the opportunity cost of prevention. One important result that comes from this model is the theoretical ambiguity of the effects of health insurance on the prevention effort. The level of insurance coverage affects premiums and these changes alter both the marginal costs and benefits of prevention. The net effect is ambiguous and therefore becomes an empirical question.[2]

The possibility of ex post moral hazard also must be considered in making predictions of the effects of health insurance on obesity status. This may arise if insurance coverage encourages people to visit the doctor, and the treatment they receive (perhaps in the form of advice) encourages weight loss (Dave and Kaestner 2006; Kant and Miner 2007; Loureiro and Nayga 2006). In this case, a negative relationship would arise between insurance coverage and obesity. On the other hand, there is some evidence of the minimal effectiveness of physician counseling on the diet and exercise behaviors of patients (Wee et al. 1999; Clark 1991; Ammerman et al. 1993). Nevertheless, to help ensure that ex post moral hazard is not

[2] See Zweifel and Manning (2000) for details.

confounding our results, we limit our estimation sample to only those people who have not seen doctor a within the past year of the survey.

Lastly, results from the Grossman (1972) model further complicate the relationship between obesity and health insurance in that health status may determine insurance status, and other factors may influence or be influenced by both body weight and health insurance. For example, those who are obese are more likely to have certain illnesses or to seek insurance against their potential future maladies. Alternatively, obese persons may have a time preference for the present (or discount the future more heavily than non-obese persons) and choose not to have insurance. We use instrumental variables to avoid these confounding effects.

The regression in which we are most interested is of the following form:

(1) $Body\ weight_i = \alpha_0 + \alpha_1\ HealthIns_i + \alpha_2 X_i + \alpha_3 U_i + \varepsilon_1,$

where *i* indexes individual observations, *Body weight* represents one of three measures of weight (discussed below), *HealthIns* is a dichotomous indicator for health insurance, and X_i represents the vector of other relevant variables such as the probability of illness, the potential monetary loss from illness, labor supply, and wages. As discussed below, we include measures for income and education, but unfortunately, some of the variables that are important in the theoretical model are not available in existing data sets. While demographic and socioeconomic variables will help control for some of these unobserved factors, we recognize that many of these factors will remain unobserved in the error term.

Another problem to consider occurs when health insurance status is determined by weight:

(2) $HealthIns_i = \beta_0 + \beta_1 Body\ weight_i + \beta_2 X_i + \beta_3 F_i + \beta_4 U_i + \varepsilon_2,$

where the variables are the same as in equation (1), and F_i represents variables that predict health insurance status but not body weight. Given this, a simple estimation of equation (1) will yield a biased estimate of the coefficient on health insurance if there are common unobservable factors (U_i) influencing both weight ($\alpha_3 \neq 0$) and health insurance ($\beta_4 \neq 0$), which is analogous to an omitted variable bias, or if weight is a determinant of health insurance status ($\beta_1 \neq 0$). Our estimation techniques attempt to address all of these sources of endogeneity. Details are discussed below.

We empirically estimate equation (1) using a pooled cross-section of individuals over time. Our goal is to obtain a consistent estimate the effect of health insurance on measures of body weight. Assuming we are able to avoid the problems of endogeneity, a positive coefficient is indicative of the presence of ex ante moral hazard; that is, having health insurance leads to unhealthy behaviors that contribute to larger body weights. A zero or negative coefficient will indicate the absence of any ex ante moral hazard effect.

IV. Data

Ten years of individual-level data from the Behavioral Risk Factor Surveillance System (BRFSS), 1993-2002, are used in our analysis. As the largest telephone-based health survey available, the BRFSS has tracked health conditions and risk behaviors for adults in the U.S. since 1984. The survey is conducted by state health departments in collaboration with the Centers for Disease Control. Not all states are included in the early years of the data; however, forty-nine states plus the District of Columbia are included by 1993, our first year of analysis. We begin in 1993 and end in 2002 since these are the years for which information is available on all of our variables of interest. These data are publicly available from the Centers for Disease Control.

Information on self-reported body weight and height are available in all years of data. Using this information, we create some measures of weight: The Body Mass Index (BMI), a dichotomous indicator of being overweight or obese, and a dichotomous indicator of being classified as obese. BMI is defined as weight in kilograms divided by height in squared meters, and it is the measure that the National Institutes of Health use to track obesity over time. The dichotomous indicator of overweight or obese is equal to 1 for individuals with a body mass index greater than or equal to 25 kg/m^2, and the dichotomous indicator for obesity is equal to 1 for individuals with a body mass index greater than or equal to 30 kg/m^2. We also examine a dichotomous indicator of being overweight only – that is, anyone who is recorded as obese is excluded from the analysis so the comparison is overweight versus normal or underweight.

While some measures of obesity, such as biometrical impedance analysis (BIA), may be more superior measures of obesity (Burkhauser and Cawley 2008; Wada and Tekin 2007), they are costly and are not routinely measured in physical examinations. The body mass index is a nationally representative measure that fairly accurately measures weight changes over time. To somewhat mitigate error due to self-reports, we use objective measures of weight and height from the third National Health and Nutrition Examination Survey (NHANES) to construct an adjusted, more accurate measure of obesity. Because NHANES gathers information on both self-reported and actual weight and height, we adjust BMI in the BRFSS using this information. This is done separately by age, gender, and race, and has previously been used (Chou et al. 2004; Cawley 1999).[3]

The BRFSS data also include information on personal characteristics. Health insurance is measured by a dichotomous indicator for whether or not the individual has any kind of health

[3] We find that the correlation between BMI and adjusted BMI is 0.99. Regression results using BMI and adjusted BMI are also very similar.

care coverage, be it from private or public sources. Other personal characteristics include the following variables: Age and age squared; gender; race or ethnic category as represented by indicators for white (the omitted reference category), black, Hispanic, and other race; level of education as represented by dichotomous indicators for less than high school (the omitted reference category), some high school, high school degree, and college degree; family income and income squared; marital status; and the number of children under 18 in the household.[4] We limit our sample to individuals between the ages of 25 and 55. We exclude those under age 25 because the time preferences of these individuals may make their incentives and outcomes very different from older individuals. We exclude those older than 55 to avoid potential changes in behaviors brought on by the anticipated receipt of Medicare.[5]

In line with Chou et al. (2004) and Rashad et al. (2006), we also include in all models some state-level variables that have been shown to be important determinants of obesity status and body weights. These are state-level food, soft drink, and cigarette prices. These prices are obtained from ACCRA and are given for various cities across the U.S. every quarter. The ACCRA food-at-home price is made up of a weighted average of thirteen food prices, in which the weights are the reported average expenditure shares of these food items by consumers according to ACCRA. These thirteen foods are: steak, beef, sausage, chicken, tuna, milk, eggs, margarine, cheese, potatoes, bananas, lettuce, and bread. The ACCRA fast-food price is formed by taking the average prices of a hamburger (McDonald's), a pizza (Pizza Hut), and fried chicken (KFC).[6] The price of a 2-liter bottle of Coca Cola is included as a proxy for soft drink

[4] We recognize that some of these variables may be endogenous as well. Models were tested that excluded the potentially endogenous variables and the conclusions remain the same.

[5] We also stratify the sample by poverty status, using yearly age- and family size-specific thresholds from the Bureau of Labor Statistics, to avoid potential changes in behaviors brought on by the anticipated receipt of Medicaid and due to the potential concern that those in poverty are already underinsured.

[6] More detail on these variables can be found in Chou et al. (2004).

prices. Cigarette prices are included due to the metabolic and appetite suppressing effects that smoking may have. A cost of living index is also reported for each city. Before averaging prices in each state by quarter, we divide each price by the city's cost of living to account for regional variation in prices. The four quarters are then averaged, yielding a price for each state in each year. All annual prices are divided by the consumer price index, generating real prices in 1982-84 dollars.

All models also include state and year indicator variables. The state indicators will help to capture any unobserved time-invariant state effects which may influence obesity and may be correlated with health insurance status. Time dummies are included to capture secular trends in obesity.

V. Estimation

We use a variety of techniques to address the problems of endogeneity of health insurance in the body weight equation and the confounding effects of ex post moral hazard. Ultimately, we rely on instrumental variable techniques to draw conclusions, but restrictions on the sample help minimize the influence of confounding factors. That being said, restrictions on the sample limit the generalizability of our results.

The first restriction we place on the sample is that we limit it to employed individuals. This restriction is useful because it helps limit the amount of unobserved heterogeneity that may be correlated with the body weight measures and insurance status. The provision of health insurance is tied intimately to the labor market and those who are unemployed may have very different characteristics and incentives than employed individuals. Also, we need this restriction since the instruments we use, the percentage of each state's workforce employed in firms of different size, works theoretically only for individuals who are employed. (More details on the instruments are below.) Note that many employed individuals, through the receipt of employer-provided health insurance, may already indirectly pay for a large portion of their health insurance, rendering our estimates of ex ante moral hazard conservative.

The second restriction limits the sample to those individuals who are classified as "healthy" and who have not visited the doctor in the past year. Healthy individuals are defined as those who report that their general health is very good or excellent, and they do not report diabetes, high cholesterol, or any heart problems.[7] The healthy sample is considered because this is a group for which reverse causality, or structural endogeneity, is less likely to be an issue since healthy persons are unlikely to purchase insurance for health reasons. In addition, this helps rule out pre-existing condition clauses that might prevent an overweight or sick person from purchasing insurance. Limiting the sample to those who have not visited the doctor in the past year is important in order to ensure that our estimated coefficients measure the ex ante rather than the ex post moral hazard. In other words, we hope to eliminate the possibility that insurance coverage lowers body weight. This would occur if insurance encourages doctor visits that lead to treatment and advice regarding weight loss.

In all tables below, ordinary least squares (OLS) and probit models provide baseline estimates. These are compared with models that directly account for the endogeneity of health insurance status.

When BMI is the dependent variable, OLS is used for the baseline model, followed by a two-stage least squares model with the percentage of each state's workforce employed in firms of sizes 100-499 employees and 500+ employees. These annual workforce data come from the

[7] We realize that this is not a perfect stratification, as respondents may not fully be aware of their health status if they have not seen a doctor in the year prior to being interviewed.

U.S. Small Business Administration. We believe that firm size is a useful instrument on a theoretical basis, as health insurance is strongly tied to employment in the United States, and firm size is a known predictor of whether health insurance is offered to employees, with individuals in large firms more likely to have health insurance (Fronstin 2006). At first glance, the instruments appear to be as valid. The coefficient in the first stage are positive, as predicted, and the F-statistic on their joint significance of 12.04 is significant and larger than the Bound et al. (1995) value of 10. The instruments also pass the overidentification test indicating that the instruments are uncorrelated with the error term and are properly excluded from the second stage equation. However, the first stage partial R-squared is extremely low, indicating that the instruments are very weak. This is also evident by the fact that the TSLS coefficient on health insurance is extremely large relative to the OLS coefficient and it becomes statistically insignificant. The Hausman test does not reject the consistency of OLS. These results make the TSLS estimates untrustworthy.

Lewbel (2007) presents an IV technique that is useful when valid external instruments are weak or unavailable. This procedure relies, in part, on the presence of heteroskedasticity in the error term of the first stage equation. A Breusch-Pagan (1979) test confirms that this heteroskedasticity is present in our model. The Lewbel IV procedure is one of TSLS that uses $(Z-\overline{Z})\hat{\varepsilon}_2$ as the identifying instruments. Here, Z is a vector of independent variables that may include any available excluded instruments, although such instruments are not a requirement and identification can be achieved without them. In addition, Z may include all independent variables or a just subset of them. $\overline{Z}$ is a vector of means of the Z variables, and $\hat{\varepsilon}_2$ is the residual from the first stage regression (health insurance on the independent variables).[8] Lewbel shows that this instrument can identify the parameter of interest when $Cov(Z, \varepsilon_2^2) \neq 0$ and $Cov(Z, \varepsilon_1 \varepsilon_2) = 0$. The model can be estimated by TSLS or GMM, and the usual tests for the validity of the instruments can be applied. We tried both estimation procedures and the results are nearly identical, so the TSLS are shown. Sabia (2007) uses this procedure to identify the effects of body weight on academic performance among adolescents and finds the Lewbel IV results to be more plausible than the TSLS results that rely on instruments of questionable validity.

When the dichotomous indicators of weight are considered (overweight/obese, obese only, overweight only), probit estimates provide baseline and bivariate probits are used to account for the endogeneity of health insurance. Identification can be achieved in the bivariate probit without external instruments, although we caution that this only works well when the distribution assumption is correct (Monfardini and Radice 2007). Models were tested with and without the firm size instruments, but the results are insensitive to their inclusion. We only show the models with the instruments, but given their weakness, we caution that the results will be biased if the assumption of joint normality is wrong.

VI. Results

Table 1 show sample means for the full sample and separately for those with and without health insurance. All three measures of body weight show a statistically significant difference in values for those with and without health insurance, with those having health insurance having a larger BMI and a higher probability of being classified as overweight. In contrast, the

[8] This model assumes that $\beta_1 = 0$ in equation 2. We believe that restricting the sample to healthy individuals with no doctor visits in the past year justifies this assumption.

probability of being obese is slightly lower for those with insurance than those without. Of course these summary statistics do not account for any confounding factors. It is not surprising that the table of means also shows that people with health insurance are more educated, are older, are married and have more children, and have higher incomes than those without health insurance.

Table 2 shows the results for BMI. The first column is the baseline OLS model. The second column uses a TSLS with the percent of the states' workforces in firms of different sizes as instruments. Column 3 presents results from the Lewbel IV, with no external instruments, and finally, Column 4 shows the Lewbel IV with the external instruments. The coefficient on having a health plan is positive in all models, and is statistically significant in the OLS and Lewbel IV models. As discussed above, the TSLS models are not trustworthy because of the weak instruments.[9] However, the Lewbel IV models appear to perform well. The instruments have strong first stage F-statistics, pass the overidentification test, and the Hausman test rejects the consistency of the OLS coefficient. The magnitude of the Lewbel IV coefficient is not sensitive to the inclusion of the external instruments (which is not surprising given their low predictive power), and indicate that a switch from no health insurance to having health insurance is associated with an increase in the BMI of 0.25 kg/m^2. To put this into context, consider an average male who is 5'10" tall and weighs 185 lbs. His BMI is 26.2. An increase in one unit of BMI translates into a weight gain of 7.1 pounds for this man, so a 0.25 unit increase is a weight gain of about 1.8 pounds. Coefficients reported in the Appendix, where the sample is stratified by poverty status, show that the statistically significant results are being driven by those above the poverty threshold and not by those officially classified as poor.

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[9] An IV model was tested using LIML, which may perform better than 2SLS with weak instruments. The results of the two estimation procedures were almost identical.

To test the threshold effects, we next turn to an analysis of whether having health insurance is associated with the probabilities of being classified as 1) overweight or obese, 2) overweight only, or 3) obese. Table 3 shows the results. The presence of health insurance is positively related to the probabilities of being overweight/obese and of being overweight. The effects appear to be concentrated on the threshold between normal weight and overweight since the models for obesity show no statistically significant effect of health insurance on the probability of being obese. All these conclusions hold whether the probit or bivariate probit is considered. Using the bivariate probit results, having insurance is associated with an increase of 11.1 percentage points in the probability of being overweight. The implication here is that there does appear to be an ex ante moral hazard effect, where individuals who have health insurance have less incentive to engage in preventative behaviors. However, the effect is small in terms of additions to BMI, and it is concentrated only along the normal-overweight boundary. There is no apparent effect of health insurance on the probability of being obese.

VII. Discussion

Few would argue that health insurance is undesirable. The benefits of insurance to the health and welfare of individuals are highly valued, and are sometimes viewed as one of the basic human rights. But of course health insurance is not without costs, and the moral hazard problems associated with insurance add to these costs. This paper examines one particular manifestation of the moral hazard problem, the ex ante moral hazard as it pertains to body weight. Our hypothesis is that in the presence of insurance, people have less incentive to guard against illness and change their health-related behaviors (i.e., poor diet and less exercise) accordingly. Using a large data set of individuals, we estimate the relationship between health insurance status and body weight accounting for the possible endogeneity of health insurance coverage.

Our results suggest a small, but measureable ex ante moral hazard problem, particularly for employed individuals above the poverty threshold. Having health insurance is associated with an increase in BMI of 0.25 kg/m^2, or approximately 1.8 additional pounds on an average male. The presence of health insurance is also associated with an increase in the probability of being classified of overweight; however, there is no statistically significant effect on the probability of being classified as obese. We caution that the results from our study are not directly comparable to that of other studies, nor are they generalizable to the adult population because of the restrictions we place on the sample. We limit our sample to those who are employed, in good health, and have no reported doctor visits in the past year. This is done to minimize the propensity for reverse causality from body weight to health insurance status and to mitigate the potential for ex post moral hazard to confound our results.

In conclusion, our results demonstrate that health insurance can lead certain individuals to change health related behaviors and to gain weight; however, the magnitude is small and the effect is concentrated only along the boundary of overweightedness. Obesity is not affected by the presence of health insurance. In other words, Americans are not getting fat because of their health insurance.

References

Abid, A., D. Galuska, L. K. Khan, C. Gillespie, E. S. Ford, and M. K. Serdula. 2005. Are Healthcare Professionals Advising Obese Patients to Lose Weight? A Trend Analysis. *Medscape General Medicine* 7(4):10.

Ammerman, A. S., R.F. DeVellis, T. S. Carey, et al. 1993. Physician-Based Diet Counseling for Cholesterol Reduction: Current Practices, Determinants, and Strategies for Improvement. *Preventive Medicine* 22(1):96-109.

Battacharya, J., and N. Sood. 2007. Health Insurance and the Obesity Externality. *Advances in Health Economics and Health Services Research* 17:279-318.

Bound, J., D. A. Jaeger, and R. M. Baker. 1995. Problems With Instrumental Variables Estimation When the Correlation between the Instruments and the Endogeneous Explanatory Variable is Weak. *Journal of the American Statistical Association* 90(430):443-450.

Breusch, T., and A. Pagan. 1979. A Simple Test for Heteroscedasticity and Random Coefficient Variation. *Econometrica* 47(5):1287-1294.

Burkhauser, R., and J. Cawley. 2008. Beyond BMI: The Value of More Accurate Measures of Fatness and Obesity in Social Science Research. *Journal of Health Economics* 27(2):519-529.

Card, D., C. Dobkin, and N. Maestas. 2004. The Impact of Nearly Universal Insurance Coverage on Health Care Utilization and Health: Evidence from Medicare. *NBER Working Paper No. 10365*.

Cawley, J. 1999. Addiction, Calories, and Body Weight. *PhD dissertation, University of Chicago*.

Cherkin, D. C., L. Grothaus, and E. H. Wagner. 1990. The Effect of Office Visit Copayments on Preventive Care Services in an HMO. *Inquiry*. 27(1):24-38.

Chou, S., M. Grossman, and H. Saffer. 2004. An Economic Analysis of Adult Obesity: Results from the Behavioral Risk Factor Surveillance System. *Journal of Health Economics* 23(3):565-587.

Clark, L. T. 1991. Improving Compliance and Increasing Control of Hypertension: Needs of Special Hypertensive Populations. *American Heart Journal* 121(2):664-669.

Conway, T., T. C. Hu, E. Mason, and C. Mueller. 1995. Are Primary Care Residents Adequately Prepared to Care for Women of Reproductive Age? *Family Planning Perspectives* 27(2):66-70.

Courbage, C., and A. de Coulon. 2004. Prevention and Private Health Insurance in the U.K. *Geneva Papers on Risk and Insurance* 29(4):719-727.

Cutler, D., E. Glaeser, and J. Shapiro. 2003. Why Have Americans Become More Obese? *Journal of Economic Perspectives* 17(3):93-118.

Dave, D., and R. Kaestner. 2006. Health Insurance and Ex Ante Moral Hazard: Evidence from Medicare. *NBER Working Paper No. 12764*.

Ehrlich, I., and G. Becker. 1972. Market Insurance, Self-Insurance and Self-Protection. *Journal of Political Economy* 80(4):623-648.

Eraker, S. A., J. P. Kirscht, and M. H. Becker. 1984. Understanding and Improving Patient Compliance. *Annals of Internal Medicine* 100(2):258-268.

Ewing, R., T. Schmid, R. Killingsworth, A. Zlot, and S. Raudenbush. 2003. Relationship between Urban Sprawl and Physical Activity, Obesity, and Morbidity. *American Journal of Health Promotion* 18(1):47-57.

Fronstin, P. 2006. Sources of Health Insurance and Characteristics of the Uninsured: Analysis of the March 2006 Current Population Survey. *EBRI Issue Brief No. 298*, October 2006.

Grossman, M. 1972. On the Concept of Health Capital and the Demand for Health. *Journal of Political Economy* 80(2):223-255.

Kant A. K., and P. Miner. 2007. Physician Advice about Being Overweight: Association With Self-Reported Weight Loss, Dietary, And Physical Activity Behaviors of U.S. Adolescents in the National Health and Nutrition Examination Survey, 1999-2002. *Pediatrics* 119(1):142-147.

Kenkel, D. S. 2000. Prevention. In *Handbook of Health Economics, Vol. 1B*, A.J. Culyer and J.P. Newhouse, eds. Amsterdam: Elsevier.

Komlos, J., P. Smith, and B. Bogin. 2004. Obesity and the Rate of Time Preference: Is There A Connection? *Journal of Biosocial Science* 36(2):209-219.

Kreuter, M. W., D. P. Scharff, L. K. Brennan, and S. N. Lukwago. 1997. Physician Recommendations for Diet and Physical Activity: Which Patients Get Advised to Change? *Preventive Medicine* 26(6):825-833.

Lakdawalla, D., and T. Philipson. 2002. The Growth of Obesity and Technological Change: A Theoretical and Empirical Examination. *NBER Working Paper No. 8946*.

Lewbel, A. 2007. Using Heteroskedasticity to Identify and Estimate Mismeasured and Endogenous Regressor Models. *Boston College Working Paper*.

Lillard L. A., W. G. Manning, C. E. Peterson, N. Lurie, G. A. Goldberg, and C. E. Phelps. 1986. Preventive Medical Care: Standards, Usage, and Efficacy. *RAND publication R-2366-HCFA.*

Loureiro, M. L., and R. M. Nayga. 2006. Obesity, Weight Loss, and Physician's Advice. *Social Science and Medicine* 62(10):2458-2468.

Monfardini, C., and Radice R. 2007. Testing Exogeneity in the Bivariate Probit Model: A Monte Carlo Study. *Oxford Bulletin of Economics and Statistics* 70(2):271-282.

Mokdad, A. H., E. S. Ford, B. A. Bowman, W. H. Dietz, F. Vinicor, V. S. Bales, and J. S. Marks. 2003. Prevalence of Obesity, Diabetes, and Obesity-Related Health Risk Factors, 2001. *Journal of the American Medical Association* 289(1):76-79.

Must, A., J. Spadano, E. H.Coakley, A. E.Field, G. Colditz, and W. H. Dietz. 1999. The Disease Burden Associated With Overweight and Obesity. *Journal of the American Medical Association* 282(16):1523-1529.

Nagasawa, M., M. C. Smith, J. H. Barnes, and J. E. Fincham. 1990. Meta-Analysis of Correlates of Diabetes Patients' Compliance With Prescribed Medications. *Diabetes Education* 16(3):192-200.

Newhouse, J. P. (1993). *Free for All? Lessons from the RAND Health Insurance Experiment*. Cambridge MA: Harvard University Press.

Philipson, T. 2001. The World-Wide Growth in Obesity: An Economic Research Agenda. *Health Economics* 10(1):1-7.

Rashad, I., M. Grossman, and S. Chou. 2006. The Super Size of America: An Economic Estimation of Body Mass Index and Obesity in Adults. *Eastern Economic Journal* 32(1):133-148.

RNIB. 2006. Obese People Twice As Likely to Go Blind. *Royal National Institute of the Blind Press Release*, September 6.

Roddy, P. C., J. Wallen, and S. M. Meyers. 1986. Cost Sharing and Use of Health Services: The United Mine Workers of America Health Plan. *Medical Care* 24(9):873-876.

Sabia, J. J. 2007. The Effect of Body Weight on Adolescent Academic Performance. *Southern Economic Journal* 73(4):871-900.

Smith, P. K., B. Bogin, and D. Bishai. 2005. Are Time Preference and Body Mass Index Associated? Evidence from the National Longitudinal Survey of Youth. *Economics and Human Biology* 3(2):259-270.

Taira, D. A., D. G. Safran, T. B. Seto, W. H. Rogers, and A. R. Tarlov. 1997. The Relationship between Patient Income and Physician Discussion of Health Risk Behaviors. *Journal of the American Medical Association* 278(17):1412-1417.

Wada, R., and E. Tekin. 2007. Body Composition and Wages. *NBER Working Paper No. 13595*.

Wee, C. C., E. P. McCarthy, R. B. Davis, and R. S. Phillips. 1999. Physician Counseling about Exercise. *Journal of the American Medical Association* 282(16):1583-1588.

Zhang, L., and I. Rashad. 2008. Time Preference and Obesity: The Health Consequences of Discounting the Future. *Journal of Biosocial Science* 40(1):97-113.

Zweifel, P., and W. G. Manning. 2000. Moral Hazard and Consumer Incentives in Health Care. In *Handbook of Health Economics, pp.409-459,* A.J. Culyer and J.P. Newhouse, eds. Amsterdam: Elsevier.

Figure 1

Share of All Health Expenditures by Source, 1960-2004
Centers for Medicare and Medicaid Services
U.S. Department of Health and Human Services

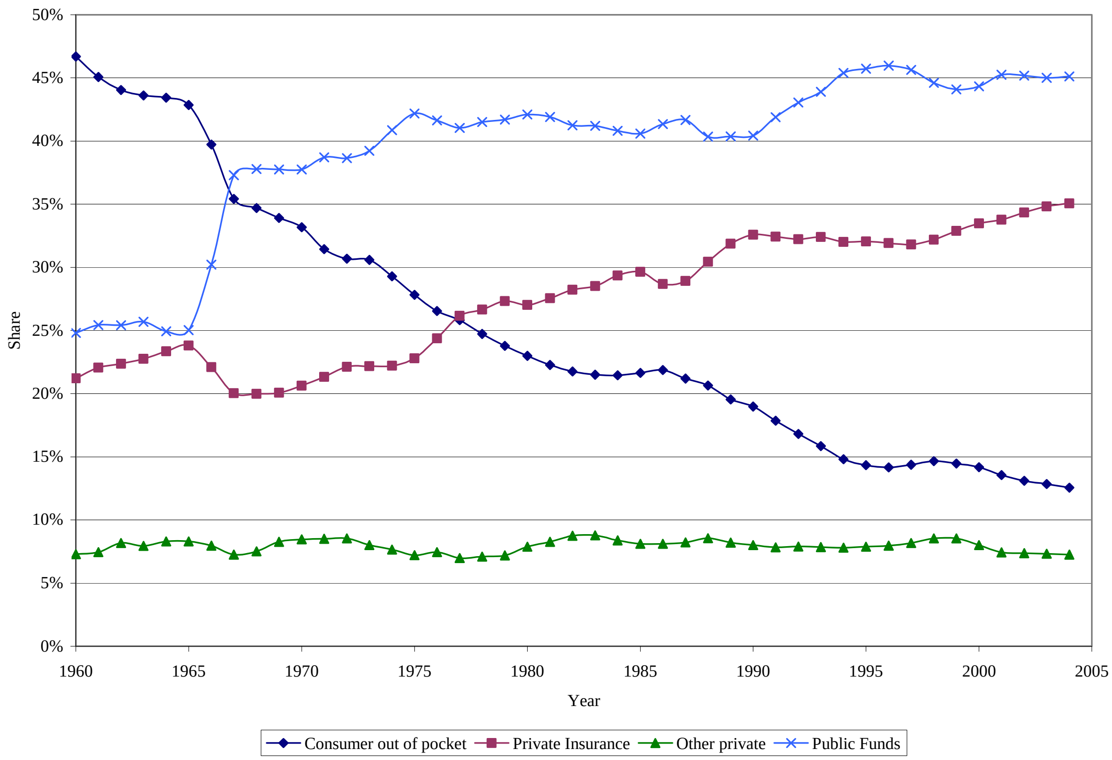

Table 1
Weighted Sample Means/Proportions
(Standard Deviations)

Variable	**Description**	All Respondents (n=109,788)	**Without Health Insurance** (n=17,066)	**With Health Insurance** (n=92,722)
BMI	Body mass index, measured as weight in kilograms divided by height in squared meters	26.13 (4.42)	26.03 (4.79)	26.15 (4.34)
Overweight/obese	Dichotomous variable that equals 1 if BMI is equal to or greater than 25 kg/m^2	0.56	0.53	0.56
Overweight*	Dichotomous variable that equals 1 if BMI is equal to or greater than 25 kg/m^2 and less than 30 kg/m^2	0.47	0.43	0.48
Obese	Dichotomous variable that equals 1 if BMI is equal to or greater than 30 kg/m^2	0.16	0.17	0.16
Health insurance	Dichotomous variable that equals 1 if respondent has some form of health insurance coverage	0.84	-	-
High school	Dichotomous variable that equals 1 if respondent completed exactly 12 years of formal schooling	0.28	0.38	0.26
Some college	Dichotomous variable that equals 1 if respondent completed at least 13 years but fewer than 16 years of formal schooling	0.29	0.30	0.28
College	Dichotomous variable that equals 1 if respondent graduated from college	0.39	0.21	0.42
Age	Age of respondent	38.43 (7.90)	37.33 (8.13)	38.63 (7.85)
Black	Dichotomous variable that equals 1 if respondent is black but not Hispanic	0.04	0.06	0.04
Hispanic	Dichotomous variable that equals 1 if respondent is Hispanic	0.05	0.08	0.04
Other race	Dichotomous variable that equals 1 if respondent is not white, black, or Hispanic	0.03	0.04	0.03
Male	Dichotomous variable that equals 1 if respondent is male	0.64	0.61	0.65
Number of children	Number of children in the household under age 18	1.07 (1.24)	1.00 (1.30)	1.09 (1.23)
Real family income	Real household income in thousands of 1982-84 dollars	35.65 (26.97)	19.87 (17.49)	38.56 (27.40)
Married	Dichotomous variable that equals 1 if respondent is married	0.60	0.40	0.64
Divorced	Dichotomous variable that equals 1 if respondent is divorced or separated	0.18	0.28	0.16

Widowed	Dichotomous variable that equals 1 if respondent is widowed	0.01	0.02	0.01
Food at home price	Real state ACCRA food at home price divided by (the cost of living*the CPI) in 1982-84 dollars	1.03 (0.05)	1.03 (0.05)	1.03 (0.05)
Fast food price	Real state ACCRA fast food price divided by (the cost of living*the CPI) in 1982-84 dollars	2.72 (0.18)	2.73 (0.18)	2.72 (0.18)
Soda price	Real state ACCRA Coke price divided by (the cost of living*the CPI) in 1982-84 dollars	0.71 (0.09)	0.71 (0.09)	0.71 (0.09)
Cigarette price	Real state ACCRA cigarette price divided by (the cost of living*the CPI) in 1982-84 dollars	12.97 (2.91)	12.98 (2.89)	12.97 (2.91)

*Sample omits individuals classified as obese. N=92,086.
Note: Difference between those with health insurance and those without health insurance is statistically significant at the 10% level for all variables except the food at home price and cigarette price.

Table 2
Effects of Health Insurance on BMI

	(1)	(2)	(3)	(4)
	OLS	IV	Lewbel IV, No Instruments	Lewbel IV, With Instruments
Health insurance	0.147*** (3.78)	2.270 (0.85)	0.247*** (4.04)	0.249*** (4.06)
High school	-0.090 (1.32)	-0.320 (1.08)	-0.101 (1.47)	-0.101 (1.47)
Some college	-0.113 (1.64)	-0.392 (1.10)	-0.126* (1.82)	-0.127* (1.82)
College	-0.695*** (9.97)	-1.045** (2.34)	-0.712*** (10.15)	-0.712*** (10.15)
Age	0.071*** (4.29)	0.057** (2.26)	0.071*** (4.25)	0.071*** (4.25)
Age squared	-0.0002 (1.15)	-0.0001 (0.23)	-0.0002 (1.11)	-0.0002 (1.11)
Black	1.246*** (18.47)	1.265*** (17.53)	1.247*** (18.48)	1.247*** (18.48)
Hispanic	0.688*** (10.76)	0.722*** (9.30)	0.690*** (10.79)	0.690*** (10.79)
Other race	-0.619*** (8.27)	-0.582*** (6.57)	-0.617*** (8.25)	-0.617*** (8.25)
Male	1.309*** (47.36)	1.326*** (37.99)	1.310*** (47.38)	1.310*** (47.38)
Number of children	0.087*** (7.07)	0.099*** (4.97)	0.087*** (7.11)	0.087*** (7.11)
Income	-0.004 (1.46)	-0.041 (0.88)	-0.006** (2.03)	-0.006** (2.04)
Income squared	0.00001 (0.25)	0.0003 (0.81)	0.00002 (0.82)	0.00002 (0.82)
Married	0.142*** (3.60)	0.012 (0.07)	0.136*** (3.43)	0.136*** (3.43)
Divorced	-0.390*** (8.66)	-0.403*** (8.31)	-0.390*** (8.67)	-0.390*** (8.67)
Widowed	0.021 (0.16)	-0.022 (0.15)	0.019 (0.14)	0.019 (0.14)
Food at home price	-0.042 (0.07)	0.104 (0.17)	-0.035 (0.06)	-0.035 (0.06)
Fast food price	-0.065 (0.34)	-0.004 (0.02)	-0.062 (0.32)	-0.062 (0.32)
Soda price	0.050 (0.13)	-0.069 (0.16)	0.045 (0.11)	0.045 (0.11)
Cigarette price	0.029* (1.73)	0.022 (1.17)	0.028* (1.71)	0.028* (1.71)
Observations	109,788	109,788	109,788	109,788
F-test on instruments		12.04 [0.000]	951.92 [0.000]	906.24 [0.000]
Overidentification test		0.534 [0.465]	94.845 [0.0943]	97.773 [0.1128]
Hausman test		0.58 [0.447]	4.49 [0.034]	4.58 [0.032]

Note: Absolute value of t-statistics in parentheses, p-values in brackets, and intercept not shown. Models also include state indicators, year indicators, and missing observation indicators for price variables. Instruments are the percent of the workforce in firms of sizes 100-499 and 500+.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3
Marginal Effects of Health Insurance on Probabilities of Overweight and Obese

	(1)	(2)	(3)	(4)	(5)	(6)
	Overweight/obese		Overweight		Obese	
	Probit	Biprobit	Probit	Biprobit	Probit	Biprobit
Health insurance	0.019*** (4.13)	0.093*** (4.07)	0.020*** (4.01)	0.111*** (4.52)	0.004 (1.30)	0.016 (0.84)
High school	0.015* (1.92)	0.008 (0.90)	0.032*** (3.51)	0.022** (2.32)	-0.015*** (2.80)	-0.016*** (2.84)
Some college	0.006 (0.77)	-0.003 (0.39)	0.021** (2.32)	0.009 (0.93)	-0.016*** (2.85)	-0.017*** (2.86)
College	-0.055*** (6.75)	-0.067*** (7.53)	-0.029*** (3.15)	-0.044*** (4.42)	-0.052*** (9.56)	-0.054*** (8.67)
Age	0.008*** (3.85)	0.007*** (3.56)	0.007*** (3.29)	0.007*** (3.01)	0.003** (1.98)	0.003* (1.91)
Age squared	-0.00002 (0.98)	-0.00002 (0.73)	-0.00003 (1.03)	-0.00002 (0.78)	-0.000001 (0.04)	0.0000003 (0.02)
Black	0.100*** (12.90)	0.101*** (12.96)	0.070*** (7.75)	0.070*** (7.80)	0.077*** (12.86)	0.077*** (12.88)
Hispanic	0.093*** (12.63)	0.094*** (12.76)	0.094*** (11.24)	0.095*** (11.41)	0.035*** (6.25)	0.035*** (6.28)
Other race	-0.083*** (9.42)	-0.082*** (9.25)	-0.077*** (8.18)	-0.075*** (8.00)	-0.033*** (5.09)	-0.032*** (5.05)
Male	0.210*** (65.02)	0.210*** (65.11)	0.243*** (69.02)	0.243*** (69.01)	0.011*** (4.60)	0.011*** (4.63)
Number of children	0.008*** (5.62)	0.009*** (5.89)	0.006*** (3.59)	0.006*** (3.90)	0.005*** (4.71)	0.005*** (4.75)
Income	0.001*** (4.20)	0.00001 (0.02)	0.003*** (7.73)	0.001* (1.82)	-0.001*** (5.87)	-0.002*** (3.74)
Income squared	-0.00001*** (4.14)	-0.000001 (0.25)	-0.00002*** (6.99)	-0.00001* (1.76)	0.00001*** (4.35)	0.00001*** (3.06)
Married	0.043*** (9.25)	0.038*** (7.90)	0.052*** (10.17)	0.046*** (8.56)	0.005 (1.45)	0.004 (1.15)
Divorced	-0.012** (2.24)	-0.012** (2.33)	0.007 (1.25)	0.007 (1.13)	-0.029*** (7.90)	-0.029*** (7.92)
Widowed	0.016 (1.02)	0.014 (0.92)	0.018 (1.02)	0.015 (0.89)	0.002 (0.15)	0.001 (0.12)
Food at home price	-0.026 (0.38)	-0.021 (0.30)	-0.050 (0.65)	-0.046 (0.61)	0.039 (0.78)	0.040 (0.80)
Fast food price	-0.032 (1.40)	-0.030 (1.30)	-0.054** (2.14)	-0.050** (1.99)	0.024 (1.40)	0.024 (1.42)
Soda price	0.010 (0.22)	0.006 (0.13)	-0.003 (0.05)	-0.008 (0.16)	0.031 (0.90)	0.030 (0.88)
Cigarette price	0.002 (0.95)	0.002 (0.83)	0.0003 (0.14)	0.00002 (0.01)	0.003** (1.99)	0.003* (1.96)
Observations	109,788	109,788	92,086	92,086	109,788	109,788
Rho		-0.106		-0.132		-0.028
Chi^2 Test of rho=0		10.643 [0.001]		13.857 [0.000]		0.397 [0.528]

Note: Absolute value of t-statistics in parentheses, p-values in brackets, and intercept not shown. Marginal effects reported. Models also include state indicators, year indicators, and missing observation indicators for price variables. Instruments are the percent of the workforce in firms of sizes 100-499 and 500+.
* significant at 10%; ** significant at 5%; *** significant at 1%

Appendix
Effects of Health Insurance on BMI, by Poverty Status

	(1)	(2)	(3)	(4)
	OLS	IV	Lewbel IV, No Instruments	Lewbel IV, With Instruments
In Poverty				
Health insurance	0.444*** (2.84)	1.765 (1.00)	0.459 (0.56)	0.486 (0.68)
Observations	4,769	4,769	4,769	4,769
Not In Poverty				
Health insurance	0.134*** (3.30)	5.872 (0.73)	0.220*** (3.47)	0.222*** (3.49)
Observations	105,019	105,019	105,019	105,019

Note: Absolute value of t-statistics in parentheses, p-values in brackets, and intercept not shown. Models also include education, age, race/ethnicity, gender, number of children, family income, marital status, prices, state indicators, year indicators, and missing observation indicators for price variables. Instruments are the percent of the workforce in firms of sizes 100-499 and 500+.
* significant at 10%; ** significant at 5%; *** significant at 1%