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ESSAYS IN HEALTH ECONOMICS

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ABSTRACT OF DISSERTATION

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ESSAYS IN HEALTH ECONOMICS

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A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
College of Business and Economics
at the University of Kentucky

By

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Washington, DC

Director: Dr. Glenn Blomquist, Professor of Economics and Public Policy

Lexington, Kentucky

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ESSAYS IN HEALTH ECONOMICS

Health and health care are dominant economic and political issues in the United States and many other countries. This dissertation contains two essays addressing different subjects within the field of health economics. The first essay is labor market oriented: "An Economic Analysis of the Effects of Obesity on Wages." It examines the effects of overweight and obesity on the wages of men and women. The second essay, "An Economic Analysis of the Impact on Health Care of Certain Medicare Provisions of the Balanced Budget Act of 1997" examines changes in the treatment of Medicare patients in light of reimbursement changes brought about by the Balanced Budget Act of 1997.

This analysis contained in "An Economic Analysis of Obesity on Wages" improves on previous work by using a dataset that can allow health effects to be better examined. Three series of regressions are performed, where log wage income is regressed on a series of variables including categorical variables based on body mass index. In contrast to some previous research, this analysis finds that the wages of obese individuals are not depressed by excess weight. It is possible that, because of the increasing prevalence of overweight and obesity over the last 20 years, any associated stigma has dwindled.

"An Economic Analysis of the Impact on Health Care of the Balanced Budget Act of 1997" examines the effects of one of the provisions of the Balanced Budget Act of 1997. Specifically, the analysis examines the implementation of the Post Acute Care Transfer policy, a change to Medicare Part A, caused the length of stay for patients grouped in certain targeted diagnosis related groups (DRGs) to increase, keeping with the goal of the policy change. In analyzing the short-stay patients, the data show that patients who were grouped into the pilot DRGs and were transferred after 10/01/98 (the effective date of the policy) were not in the hospital longer than before 10/01/98, implying that hospitals might not have been exploiting a financial loophole, as thought by the Health Care Financing Administration, now the Centers for Medicare and Medicaid Services.

KEYWORDS: Health Economics, Obesity, Wages, Medicare, Hospitals

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RULES FOR THE USE OF DISSERTATIONS

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Chapter 1

Introduction

Health and health care are dominant economic and political issues in the United States and many other countries. It is no wonder that health economics has emerged as a distinct specialty within economics: According to the Centers for Medicare and Medicaid Services, by 2016, health care spending in the United States is projected to reach $4.1 trillion and 19.6 percent of GDP (www.cms.hhs.gov). Increases in spending are anticipated be primarily in the areas of hospital care, home health services, drugs and public health programs. Health economics is defined as the study of how resources are allocated to and within the health economy, including the production of health care and its distribution across populations (Folland, Goodman and Stano 2000).

Does Economics Apply?

A frequent complaint about economics is that it is irrelevant to the study of health and health care. However, if economics is simply the study of how scarce resources are used to produce and distribute goods and services, then economics certainly applies. Also, many have argued that the purchase of health care is different than the purchase of a car, for example, and, therefore, consumers do not respond to financial incentives. The argument often points to the emergency nature of some situations, like heart attacks. However, much of health care does not fit this emergency nature. Rather, much of health care is routine or elective, involving problems such as upper respiratory infections, back pain and checkups. Furthermore, data from the RAND Health Insurance Experiment (Manning, et al 1987) point to the idea that economic incentives do matter.

Kenneth Arrow (1963) helped establish health economics as a field. He stressed the prevalence of uncertainty in healthcare, both on the demand side and the supply side. Consumers are uncertain of their health status and need for health care in any future time period, implying that the demand for health care is irregular in nature from the individual's perspective. On the supply side, consumers often do not know the expected outcomes of various treatments without their doctors' advice. Often, doctors themselves cannot predict the outcomes of treatments with certainty.

The problem of uncertainty can in part be attributed to a lack of information. Actual and potential information problems in health care markets raise many economic questions. Sometimes information is unavailable to all parties concerned. At other times, the information in question is known to some parties but not to all. The purchase of health goods departs from the model of perfect information. Consumers may not know which physicians or hospitals are of good quality. They may not know whether they are ill or what should be done if they are. This lack of information makes the consumer, the principal, dependent on the provider, the agent. The provider offers both the information and the service, leading to the possibility of conflicting interests.

The Analyses Performed in this Dissertation

Health economics touches on a variety of fields within economics. Investigating hospital behavior can involve borrowing from the field of industrial organization. Examinations of health insurance could involve techniques developed in labor economics. Discussions of government health care programs such as Medicare or Medicaid involve public economics.

This dissertation contains two essays addressing different subjects within the field of health economics. The first essay is labor market oriented: "An Economic Analysis of the Effects of Obesity on Wages." It examines, as the title implies, the effects of overweight and obesity on the wages of men and women. The second essay, "An Economic Analysis of the Impact of Health and Health Care of Certain Medicare Provisions of the Balanced Budget Act of 1997" examines changes in the treatment of Medicare patients in light of reimbursement changes brought about by the Balanced Budget Act of 1997.

Both essays address issues interesting to health economists and have broad ties to public policy. For example, while it can be argued that obesity is a result of private choices, the increases in the rates of obesity over the last decades may be an unintended result of economic progress, as discussed in Culter, Glaeser and Shapiro (2003). If overweight persons consume more health care, financial externalities may exist, which can open the door for government intervention

When thinking about the Medicare program, it is important to understand that the aging of the population represents a profound demographic shift which will surely shape our budgetary and economic future. The Census Bureau anticipates that, by 2050, the U.S. population aged 65 and over will increase by nearly 52 million (www.census.gov). If medical costs generally increase with age, this increase in the aged population will stress the Medicare program, raising policy issues of funding, reimbursement and coverage of health care.

The dissertation is organized the following way: Chapter 2 contains the essay, "An Economic Analysis of the Effects of Obesity on Wages," and Chapter 3 contains the essay, "An Economic Analysis of the Impact on Health Care of Certain Medicare Provisions of the Balanced Budget Act of 1997." Both essays are briefly introduced below. Chapter 4, the conclusion, contains some final thoughts.

An Economic Analysis of the Impact of the Effects of Obesity on Wages

It is currently estimated that approximately one-third of all Americans are classified as obese Between 1976–1980 and 2003–2004, the prevalence of obesity among adults aged 20–74 years increased from 15.0% to 32.9% (www.cdc.gov).

Overweight and obesity are primarily measured by the body mass index (BMI). BMI is defined as weight in kilograms divided by the square of height in meters. Another way to calculate BMI is by the following (www.cdc.gov):

$$BMI = \left(\frac{\text{Weight in Pounds}}{(\text{Height in inches}) \times (\text{Height in inches})} \right) \times 703$$

This measure is cited as being more reliable than weight alone, since it adjusts for height. However, it does fall victim to inaccurate reporting, since people may have a tendency to overestimate height and underestimate weight. According to the Centers for Disease Control and Prevention, “overweight” is defined as a BMI of between 25 and 29.9, and “obese” is defined as a BMI of greater than 30. Individuals with normal weight will have a BMI between 18 and 24.9. Those who are underweight will have a BMI of less than 18.

The increasing prevalence of obesity over the last 20 years is a major public health concern because of the association with several chronic diseases including Type 2 diabetes, coronary heart disease, cancer and musculoskeletal disorders. Excess weight is associated with many chronic illnesses. If overweight individuals consume more health care, financial externalities exist, particularly if the health care is publicly financed. These financial externalities could be large, since it is possible for individuals with these illnesses to live relatively long lives.

While this analysis does not examine health care costs of overweight and obesity, it does examine the “cost” of overweight and obesity in terms of effects on income. Past research has shown that overweight and obesity is detrimental to wages, particularly for women. For example, Register and Williams (1990) found that obese females earn more than 12% less than comparable non-obese females, while finding no significant effect of obesity on the earnings of males. Hamermesh and Biddle (1994) examined the impact of physical looks on earnings. All other factors constant, the wages of below average looking workers were less than wages of above average looking workers. Averett and Korenman (1996) found that obese women have lower family incomes than women whose weight for height is within the recommended range. Results for men are mixed. Gortmaker, et al, (1993) found that both women and men who had been overweight were less likely to have married, had completed fewer years of education, and had lower household incomes, lower self esteem and higher rates of poverty than those who had not been overweight.

However, past research used relatively old data. Would a similar analysis with newer data yield similar results? Nearly all of the work that has been done thus far on the effects of weight on wages utilized the National Longitudinal Survey of Youth (1979), or NLSY. This analysis in this essay improves on previous work by using the Medical Expenditure Panel Survey (2000), or MEPS, which can allow health effects to be examined more completely than datasets that were utilized most frequently in the examination of this topic. The MEPS is more recent and, unlike the NLSY, economists interested in health issues, health care consumption and employment are only beginning to examine the MEPS. By using this dataset, it is possible to extend the age range of individuals examined in the research instead of focusing on youth and, while the dataset is focused on medical expenditures, it includes much more health and disability information than the NLSY and includes more variables on health insurance and healthcare consumption. The MEPS includes job information, including separate variables on occupation and industry and allows for controlling for conditions, such as blindness or asthma, which could affect income but are not related to obesity. All this additional information makes for a better rounded analysis of weight on income by controlling for factors that could also affect income.

This paper employs standard wage equations with Heckman corrections for men as well as for women. In the data used in this analysis, over half of the observations are over what is considered a healthy weight. The results are interesting because they contradict some existing research on weight and women's wages. In contrast to some previous research, this analysis finds that the wages of obese individuals are not depressed by excess weight. It is possible that, because of the increasing prevalence of overweight and obesity over the last 20 years, any associated stigma has dwindled.

An Economic Analysis of the Impact on Health Care of Certain Medicare Provisions of the Balanced Budget Act of 1997

Before the enactment of the Medicare program (Title XVIII of the Social Security Act) in 1965, older persons generally had either inadequate or no health insurance (www.cms.hhs.gov). Older individuals trying to buy health insurance privately were often denied coverage on the basis of age or pre-existing conditions while others simply could not afford the cost of such coverage. Without health insurance, the choices for older adults needing health care were few. In the decades since Medicare's enactment, the program has seen changes and refinements, most notably from the transition from retrospective payment to prospective payment. Medicare continues to evolve, as the program faces insolvency and an aging population.

The focus of the paper in this dissertation is on the changes to Medicare Part A brought about by the Post Acute Care Transfer Policy provision of the Balanced Budget Act of 1997. One of the biggest motivations of changes to

Medicare policy was the pending collapse of Medicare Part A. By early 1997, Medicare Part A was forecasted to become insolvent during 2001 (Guterman 2000).

The Balanced Budget Act instructed the Health Care Financing Administration (now the Centers for Medicare and Medicaid Services) to identify 10 diagnosis related groups (DRGs) to test the feasibility of extending the existing prospective payment system (PPS) acute care transfer payment policy to post acute, or post-hospital settings, the intent being to decrease the financial incentive to prematurely transfer patients from hospitals to acute care settings.

The data used in this analysis is the 1998-2000 Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency of Healthcare Research and Quality (AHRQ). They contain information on diagnoses, admission and discharge status such as whether the patient was admitted through the emergency room or on a weekend and whether the patient was discharged into post-acute care, to home, or died. Patient demographics and basic hospital characteristics including ownership type, region, teaching status and bed size are also available. While several regressions are run, the main thrust of the analysis is the examination of the “short stay” patients. In analyzing the short-stay patients, the data show that patients who were grouped into the pilot DRGs and were transferred after 10/01/98 (the effective date of the policy) were not in the hospital longer than before 10/01/98, implying that hospitals might not have been exploiting a financial loophole, as thought by the Health Care Financing Administration, now the Centers for Medicare and Medicaid Services.

The two essays are as follows: as outlined above, Chapter 2 is entitled "An Economic Analysis of Obesity on Wages." Chapter 3 is entitled "An Economic Analysis of the Impact of Health Care of Certain Medicare Provisions of the Balanced Budget Act of 1997." Chapter 4 presents concluding thoughts.

Chapter 2
An Economic Analysis of Obesity on Wages

Introduction

In "The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity" (2001), former United States Surgeon General Dr. David Satcher states the following:

> "Overweight and obesity may not be infectious diseases, but they have reached epidemic proportions in the United States. Overweight and obesity are increasing in both genders and among all population groups. In 1999, an estimated 61 percent of U.S. adults were overweight or obese, and 13 percent of children and adolescents were overweight. Today there are nearly twice as many overweight children and almost three times as many overweight adolescents as there were in 1980. We already are seeing tragic results from these trends. Approximately 300,000 deaths a year in this country are currently associated with overweight and obesity. Left unabated, overweight and obesity may soon cause as much preventable disease and death as cigarette smoking."

In his speech before the Harvard School of Public Health on July 1, 2003, Food and Drug Administration Commissioner Mark McClellan addressed what he claimed was one of our "most pressing public health problems":

> "The consequences of poor diets, including the growing prevalence of excess weight, and growing risks of diabetes, high blood pressure, heart disease, arthritis, respiratory difficulties, and many cancers that go along with it, is endangering and diminishing the lives of millions of Americans."

Comments made by the former Surgeon General and the former Commissioner shed light on a complex public health concern encompassing several issues: poor diet, increases in the prevalence of overweight and obesity, and the connection to a variety of chronic illnesses. The increasing prevalence of obesity is a major public health concern because obesity is associated with several chronic diseases: diabetes, heart disease, and certain types of cancer.

However, why would an economist be interested in obesity and related issues, such as diet and its relation to chronic illness, and what is the federal government's interest in obesity? As pointed out in Anderson, et al. (2003), there is a small body of economic literature devoted to obesity and its related issues[1]. The federal government has long been interested in health and nutrition issues, introducing the Food Pyramid (now called My Pyramid) and developing an entire website devoted to health and nutrition, http://www.nutrition.gov.

According to the Grossman model of the demand for health capital (1972), health is both consumption and an investment good. It is a consumption good because it makes people feel better and it is an investment good because good health enhances earning capacity. The model regards the consumer as a producer who buys market inputs (such as food, medical care and clothing) and combines them with time to produce services, which increase utility. The services are performed in the labor market for wages which are then used to purchase more market inputs. What social public health professionals and social scientists, including economists, are observing is the phenomenon that overweight and obesity rates have been increasing, particularly in the last two decades. According to the Grossman model, this is a result of individuals eating more or exercising less, or both, but it could be assumed that these are both utility-enhancing. This tradeoff between health and earnings implies that obesity has labor market effects.

[1] See Lakadawalla and Philipson (2002), Cutler, et al. (2002) and Finkelstein et al. (2003), among other papers reviewed in the Review of Relevant Literature.

The simplest explanation as to why both economists and governments are interested in obesity issues is the possible presence of externalities. This possibility should be of concern, even if we believe obesity and overweight is the result of individuals acting in their own self interest. Excess body weight is associated with many chronic illnesses and, if overweight individuals consume more health care, financial externalities exist, particularly if the health care is publicly financed. Given advances over time in the care of chronic illnesses such as hypertension and diabetes[2], these financial externalities could be large, since it is possible for individuals with these illnesses to live relatively long lives. This may be different from smokers, who generate financial externalities through greater consumption of medical services but, since smokers tend to live shorter lives than non-smokers, tend to consume fewer resources in old age (Viscusi 1995).

Therefore, the time is right to begin examining the issues involving excess weight and obesity and attempting to tie these issues with topics familiar to economists, such as employment choices and income. While an examination of financial externalities is beyond the scope of this paper, it will address a couple of these issues, specifically employment and income. This chapter is organized in the following way: Section II introduces obesity and overweight as medical conditions: how they are defined, obesity trends, and health effects from being

[2] For example, before the discovery of insulin in 1921, diabetics often died shortly after diagnosis due to a condition known as diabetic ketoacidosis, defined as a state of absolute or relative insulin deficiency aggravated by ensuing hyperglycemia or dehydration. While it is now uncommon for this to occur, diabetics are now threatened more by heart attacks, strokes, kidney failure and infections. However, careful monitoring of the disease can reduce the likelihood of these events (www.netwellness.org,).

overweight. Section III outlines literature that has already addressed issues involving obesity. Section IV presents an analysis of wages earned by those classified as overweight or obese, and Section V concludes.

Section II

Obesity/Overweight Trends

As mentioned in the introduction, overweight and obesity have become a major healthcare concern over the last few decades. Overweight and obesity are primarily measured by the body mass index (BMI). BMI is defined as weight in kilograms divided by the square of height in meters. Another way to calculate BMI is by the following (United States Centers for Disease Control 2003):

$$\text{BMI} = \left(\frac{\text{Weight in Pounds}}{\text{(Height in inches) x (Height in inches)}} \right) \text{x } 703$$

This measure is cited as being more reliable than weight alone, since it adjusts for height. However, it does fall victim to inaccurate reporting, since people may have a tendency to overestimate height and underestimate weight.

BMI	Weight Status
Below 18	Underweight
18 – 24.9	Normal
25.0 – 29.9	Overweight
30.0 and Above	Obese

The overweight and obesity are defined by the BMI thresholds below.

Source: Centers for Disease Control and Prevention (2005)

Overweight and obesity are particularly interesting health issues since, over the last few decades, the prevalence of overweight and obesity has increased over genders, all ages, all ethnic/racial groups, all educational groups and all smoking statuses (Centers for Disease Control and Prevention 2003). Currently, it is estimated that approximately 61.3 million adults, or one-third of all Americans, are classified as obese. Between 1960 and 2000, it is estimated that the prevalence of overweight increased slightly from 31.5 to 33.6 percent among U.S. adults aged 20-74. In contrast, during the same time period, the prevalence of obesity more than doubled—from 13.3% to 30.9%, with most of the increase occurring in the last two decades (National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health [NIDDK] 2003).

The Centers for Disease Control and Prevention relate a host of chronic conditions to excess weight, including:

- High blood pressure, hypertension, high cholesterol
- Coronary heart disease, and angina pectoris (chest pain)
- Type 2 Diabetes
- Osteoarthritis
- Poor female reproductive health (such as menstrual irregularities, infertility, -i rregular ovulation)
- Bladder control problems (such as stress incontinence)
- Congestive heart failure
- Gallstones
- Obstructive sleep apnea and respiratory problems
- Stroke
- Some types of cancer (such as endometrial, breast, prostate, and colon)
- Psychological disorders (such as depression, eating disorders, distorted body image, and low self esteem).
- Uric acid nephrolithiasis (kidney stones)

Source: Centers for Disease Control and Prevention (http://www.cdc.gov/nccdphp/dnpa/obesity/)

As can be seen, the conditions associated with excess weight are extensive. While a discussion of all of the above conditions is not practical, brief discussions of conditions most associated with excess weight, diabetes and hypertension, are shown below, for informational purposes.

Diabetes

Diabetes prevents the body from using food. The pancreas produces insulin, which helps the body convert food to energy. More specifically, insulin “unlocks” the body’s cells, allowing glucose to enter and provide food. When a person has diabetes, the pancreas either does not make insulin or the body cannot use insulin properly. Without insulin, glucose, the body’s main source of energy, builds up in the blood (American Diabetes Association 2003). Diabetes can be a devastating disease. Once a person develops diabetes, his or her chance of developing conditions such as heart disease, vision problems and nerve damage increase. In addition, diabetics often require amputations of extremities due to poor circulation and nerve damage (American Diabetes Association 2003):

Three major types of diabetes exist (Centers for Disease Control and Prevention 2003), although one type, gestational diabetes, is associated with pregnancy and will not be discussed here:

Type 1 Diabetes: This type is also known as Juvenile Diabetes because it is generally diagnosed in children and young adults. Type 1 diabetes likely accounts for 5% to 10% of all cases of diabetes. While risk factors are not as well defined for type 1 diabetes compared to type 2 diabetes, it is believed that autoimmune, genetic, and environmental actors are involved in the development of this type of diabetes.

Type 2 Diabetes: About 17 million people in the U.S. have type 2 diabetes which accounts for more than 90% of all diabetes cases (NIDDK 2003). This type is most associated with excess weight. Being overweight or obese can trigger this type of diabetes because excess fat prevents insulin from working properly. Among those with Type 2 diabetes, 67% have a BMI of at least 27 and 30% have a BMI of at least 30 (NIDDK 2003). Type 2 diabetes is treated with diet and exercise, supplemented by diabetes pills or insulin, if necessary. To the extent that Type 2 diabetes is connected with excess weight, this disease is preventable by maintaining a healthy weight. In this paper, Type 2 Diabetes will be the type of diabetes of concern.

- Pre-diabetes: This is a condition that almost always precedes Type 2 diabetes, where blood glucose levels are high, but not high enough for a Type 2 diagnosis. It is estimated that approximately 20 million have pre-diabetes (NIDDK 2003).

People who might have diabetes may have some or none of the following symptoms (Centers for Disease Control and Prevention 2003):

- Frequent urination
- Excessive thirst
- Unexplained weight loss
- Extreme hunger
- Sudden vision changes
- Tingling or numbness in hands or feet
- Feeling very tired much of the time
- Very dry skin
- Sores that are slow to heal
- More infections than usual.

In addition, nausea, vomiting, or stomach pains may accompany some of these symptoms in abrupt onset of type 1 diabetes (Centers for Disease Control and Prevention 2003).

According to a report by the American Diabetes Association (2003), the total economic burden of diabetes was $132 billion in 2002. Put another way, the per capita healthcare costs for those with diabetes was $10,071 in 1997 and increased to $13,243 in 2002. Compare this to per capita costs for those who do not have diabetes: $2,560 in 2002. However, the report admits these estimates likely underestimate the true burden of diabetes, since it omits pain and suffering, value of care by nonpaid caregivers, and services such as dental and nutritional services that diabetics may utilize more often than non-diabetics.

The approach of the American Diabetes Association is to be contrasted with benefit cost analysis. Benefit cost analysis starts with the acknowledgement that the primary beneficiaries of improved control of diabetes are diabetics themselves. For benefit cost analysis the conceptual correct method for valuing better control of diabetes is based on the preferences of individuals who have diabetes or individuals who may be able to prevent diabetes. Their willingness to pay is likely to be the largest share of social benefits of controlling diabetes (Tolley, Kenkel and Fabian 1994).

Hypertension

Blood pressure is the force of the blood in the arteries. The force of the blood when the heart beats is the *systolic pressure* and the force of the blood when the heart is at rest is the *diastolic pressure*, measured in millimeters of mercury. As shown below, adult hypertension (high blood pressure) is defined as systolic pressure equal to or greater than 140 mm Hg, and diastolic pressure equal to or greater than 90 mm Hg.

American Heart Association Recommended Blood Pressure Levels

Blood Pressure Category	**Systolic (mm Hg)**		**Diastolic (mm Hg)**
Normal	less than 120	and	less than 80
Prehypertension	120-139	or	80-89
High			
Stage 1	140-159	or	90-99
Stage 2	160 or higher	or	100 or higher

The American Heart Association estimates that as many as one in four Americans have high blood pressure and nearly one-third of those who have hypertension do not know it. Along with high salt and/or alcohol consumption, lack of exercise and stress, obesity is listed as a controllable risk factor for hypertension[3]. Obesity contributes to hypertension by increasing strain on the heart.

To get a feeling for how cardiovascular disease is related to excess weight, consider the following: the prevalence of hypertension in overweight U.S. adults is 22.1% for men with BMI between 25 and 27 and 27% for men with BMI

[3] Uncontrollable risk factors include race, age and family history.

between 27 and 30. For women, the rates are slightly higher: 27.7% for women with BMI between 25 and 27 and 32.7% for women with BMI between 27 and 30. By comparison, the prevalence of hypertension in adults who are not overweight (BMI<25) is 14.9% for men and 15.2% for women.

The prevalence of high blood cholesterol (>=240mg/dL) in overweight U.S. adults is 19.1% for men with BMI between 25 and 27; 21.6% for men with BMI between 27 and 30; 30.5% for women with BMI between 25 and 27 and 29.6% for women with BMI between 27 and 30. Compare those percentages with adults who are not overweight: 13% for men and 13.4% for women (NIDDK 2003). Given these statistics, there appears to be a definite incentive to control one's weight in order to ward off heart disease.

Section III
Review of Relevant Literature

While overweight/obesity and its related chronic health issues have been examined in the medical literature (see Mokdad, et al. [2001], among others), it is a topic that is just beginning to be examined by economists in any depth.[4] Indeed, Philipson (2001) stressed the importance of an economic research agenda which examines determinants of obesity.

Lakadawalla and Philipson (2002) treated obesity as an economic phenomenon and examine the long run growth in weight over time. They argued that technological change induced weight growth by making home and market production more sedentary and by lowering food prices through agricultural innovation. They decomposed the growth in weight over the last few decades

[4] One exception is Finkelstein, et al. (2003).

and found that about 40% could be due to food supply expansion, and about 60% due to demand factors, like a fall in physical activity in market and in-home production. However, the authors did not examine behaviors associated with obesity/overweight or the corresponding link to chronic illness or medical expenditure.

Cutler, et al. (2003), also viewed the increase in obesity as a function of technological improvement. They argued that the increases in obesity rates since 1975 are a result of increased food consumption, as opposed to decreased exercise and also looks to improvements in technology for the increase. The authors stated that these improvements have led to significant decreases in time costs of food preparation. With time delay being an important mechanism for discouraging food consumption, decreases in these time costs led to increased weights.

Finkelstein, et al. (2003) attempted to estimate aggregate overweight- and obesity-attributable medical spending in the U.S. They estimated spending to be $92.6 million (in 2002 dollars) and their results suggested that per capita increase in obesity-attributable spending was greatest for Medicare patients. While the authors were able to estimate weight-related spending, no attempt was made to connect economic behavior to excess weight.

Mokdad, et al. (1999) aimed to estimate the prevalence of obesity, diabetes and use of weight control strategies among US adults in 2000. They did this using the 2000 Behavioral Risk Factor Surveillance System, with the main outcome measures being BMI, based on self-reported height and weight, self reported diabetes, prevalence of weight loss or maintenance attempts and weight control strategies used. They estimated that the prevalence of obesity was 19.8%, the prevalence of diabetes 7.3% and the prevalence of both combined was 2.9%. They concluded that the prevalence of obesity and diabetes continues to increase among US adults.

Calle et al. (2003) examined the influence of excess body weight on the risk of death due to cancer. Using data from the Cancer Prevention Study II, a dataset begun by the American Cancer Society in 1982, the authors examine BMI in 1982 and the risk of death from all cancers and from cancers at individual sites. They find that the heaviest members of this cohort had death rates from all cancers combined that were 52% higher (for men) and 62% higher (for women) than men and women of normal weight.

Kenkel (1991) examined the connection between schooling and health. Using the 1985 HPDP Supplement to the Health Interview Survey, the author concluded that the relationship between schooling and the consumption of cigarettes, alcohol and exercise is explained by differences in health knowledge. However, most of schooling's effects on health behavior remained after differences in knowledge are controlled for.

Himes (2000) used data from the Longitudinal Study of Aging and the Assets and Health Dynamics of the Oldest Old Survey to examine the effects of obesity late in life. The author found increases in the prevalence of obesity over time among those aged 70+. Obesity was most strongly related to limitations in activities of daily living (ADLs) for women and to activities related to mobility. In addition, the author found obesity was associated with an increased prevalence of arthritis, diabetes, and hypertension.

In Allison, et al. (1999), the authors attempted to estimate the number of annual deaths attributable to obesity among US adults. The authors used data from 5 prospective cohort studies: the Alameda Community Health Study, the Framingham Heart Study, the Tecumseh Community Health Study, the American Cancer Society Cancer Prevention Study I and the National Health and Nutrition Examination Survey I Epidemiologic Follow-Up Study. In addition, they used one published study, the Nurses' Health Study, in conjunction with 1991 national statistics on body mass index distributions, population size, and overall deaths. They calculated relative hazard ratios of death for obese or overweight persons and concluded that the estimated number of annual deaths attributable to obesity among US adults was approximately 280,000 based on hazard ratios from all subjects and 325,000 based on hazard ratios from only nonsmokers and never-smokers.

Stevens, et al. (1998), attempted to analyze mortality as a function of body-mass index across age groups. The authors studied 12 years' worth of data from the American Cancer Society's Cancer Prevention Study. They used proportional hazards analysis to assess associations between body-mass index and mortality from cardiovascular disease. Body-mass index was examined as both a continuous and a categorical variable. Likelihood ratio tests were used to test for interactions in the proportional hazards models. The authors find that greater body mass index was associated with higher mortality from all causes and from cardiovascular disease in men and women up to 75 years old. However, the relative risk associated with greater body-mass index declined with age. They concluded that excess body weight increases the risk from any cause and from cardiovascular disease in adults between 30 and 74 years of age. The elative risk associated with greater body weight was higher among younger subjects.

Other researchers approached obesity/overweight from a labor market standpoint. In particular, obesity is viewed as an issue of discrimination based on looks. Register and Williams (1990) aimed to determine whether there exists a wage penalty for obese individuals, who they defined by using a standard table of weight for height, as developed by The Metropolitan Life Insurance Company of New York. They asserted that the obese, due to being frequently ridiculed, suffer a social penalty similar to that of blacks, females and the disabled which carried over into the labor market. The authors used the National Longitudinal Survey of Youth to estimate earnings functions for full time workers aged 18-25 in the 1982 survey year. The earnings functions used log wage as the dependent variable, controlled for basic individual-specific characteristics and included a Heckman correction to control for selectivity bias. They found that obese females earn more than 12% less than comparable non-obese females, but no significant effect of obesity was found for the earnings of males. The authors suggested that further examining why weight matters only for females would be a worthy avenue for further research.

Loh (1993) followed up Register and Williams with an analysis of wage levels of full-time workers in the 1982 NLSY of wage changes between 1982 and 1985. He found no effect of obesity on male or female wage levels in 1982 although wages grew about 5% less between 1982 and 1985. The empirical findings showed that height positively affects wage levels among both male and female full time workers but does not affect their wage growth. Therefore, Loh stated, obesity does not lower workers' wages, but slows wage growth, particularly for men. The author admitted that better data need to be examined before any conclusion can be reached about the cause of the wage effects of height and weight. Additionally, the author suggested work on other age groups of workers since it is possible that the greater years of experience and training of more mature workers will offset the wage effects of height and weight.

Hamermesh and Biddle (1994) examined the impact of physical looks on earnings. Looks are measured using interviewers' ratings of respondents' physical appearance. The purpose was to perform the first study of labor market favoritism for the more attractive. To do this, the authors utilized three different datasets that provide information on attractiveness.

- 1977 Quality of Employment Survey
- 1971 Quality of American Life Survey
- 1981 Canadian Quality of Life Survey

They aimed to isolate the effect of beauty on earnings by controlling for as many other causes of variation as possible, using standard earnings equations. They did incorporate obese and overweight variables into the analysis, but these were determined by interviewer observation, not by self reported weight and height. They found some evidence of sorting of good looking people into professions where looks are productive and some evidence of a positive impact of workers' looks on earnings. All other variables constant, the wages of below average looking workers were less than wages of above average looking workers. They found that obese women earned about 12% less than their counterparts of "average" weight, although this difference was not statistically significant.

Averett and Korenman (1996) examined income, marital status and hourly pay differentials by body mass index corresponding to Metropolitan Life Insurance Company weight-for-height tables. They hypothesized that attempts to change the stigma attached to obesity and eating disorders is difficult if economic differences reinforce social and psychological pressures.

The authors used the 1988 NLSY, which provides data on men and women aged 23-31. They classified respondents into three categories: underweight, overweight, and obese and compare the average of BMI in 1981 and 1982 to the average BMI in 1988 and 1989. In other words, they compared BMI at ages 16 to 24 to BMI at ages 23 to 31. Like other papers, these authors found that obese women have lower family incomes than women whose weight for height is within the recommended range. Results for men were mixed.

Gortmaker, et al, (1993) also used the National Longitudinal Survey of Youth, and relied on a lagged body mass variable which addressed the idea that body mass of years ago is more exogenous to current economic status than is current body mass. This study examined data from 1981 and follow-up data in

1988 accounting for 65-79% of original cohort. In 1988, they found generally lower levels of socioeconomic attainment among the subjects who were overweight in 1981. “Crude” estimates of the difference were greater for women. Both women and men who had been overweight were less likely to have married, had completed fewer years of education, and had lower household incomes, lower self esteem and higher rates of poverty than those who had not been overweight.

Baum and Ford (2004) used the NLSY to examine the effects of obesity on wage and focus particularly on gender. They presented sample means indicating that both obese men and women experience a persistent wage penalty over the first two decades of their careers. However, after further controlling for socioeconomic and familial factors, the results did not explain why obese workers experience persistent wage penalties. The authors concluded that other variables—including job discrimination, health-related factors and/or behavior patterns of obese workers—may be the channels through which obesity adversely affects wages.

Also using the National Longitudinal Survey of Youth, Cawley (2003) tested four possible explanations for strong race and gender differences in the correlation between obesity and wages: 1. Voluntary sorting of the obese into jobs with better health benefits at the expense of lower wages, differing by gender and race; 2. Weight affects physical health and disability in a manner that varies by gender and race; 3. Weight affects self esteem or depression in a manner that varies by gender and race; 4. There is weight-based discrimination that differs by gender and race. Cawley found evidence to support the physical health and disability hypothesis, but little evidence to support the other three. However, he warned that the disability hypothesis should be interpreted with caution because the paper was unable to prove that weight causes disability.

Rosmond and Bjorntorp (1999) attempted to examine any connection between abdominal obesity and psychosocial and socio-economic handicaps for women, since connections between these variables have been found in men. They found that BMI was associated with alcohol abstinence and negatively to wine drinking. Waist to hip ratio was correlated directly with cigarette smoking and negatively with consumption of wine and beer. Both BMI and waist to hip ratio showed independent associations with low education, unemployment and problems at work when employed, as well as with little physical activity and much TV-watching. In addition, the waist to hip ratio showed a negative, independent relationship to housing conditions. The authors stated that these observations suggest psychosocial and socio-economic handicaps as well as low physical activity in abdominally obese women.

Mitra (2001) analyzed the effects of physical attributes (height and weight) on wages of males and females in “professional” and “blue-collar” occupations. An additional theme of analysis was whether physical attributes have any impact on the wages of workers with high mathematics and computational skills. Results presented in this paper showed that, among professionals and blue-collar workers, physical attributes significantly affected the wages of women and had no impact on the wages of men. Overweight women experienced significant wage penalties. Also, among women with above average quantitative skills, the effects of physical attributes on wages were insignificant.

Averett and Korenman (1999) showed that socioeconomic effects of obesity appeared larger for whites than blacks. Obesity was associated with low self-esteem among whites, but not blacks. The authors concluded that cultural differences may protect black women from the self esteem loss associated with obesity for whites. Differences in self-esteem did not account for the effects of obesity on socioeconomic status.

Pagan and Davila (1997) also examined the NLSY and utilized a multinomial logit specification in order to investigate the occupational selection of obese individuals. They found that women pay a penalty for being obese, but overweight males sort themselves into jobs that offset any penalty. They proposed that the occupational sorting among obese women may be mostly rooted in labor market discrimination.

Renna and Thakur (2006) examined the impact of obesity on labor market decisions of older adults. Using the Health and Retirement survey and a fixed effects model, they established that obesity significantly increased the probability of a worker claiming to be disabled or being retired prior to age 65. In concluding, the authors pointed out the policy implications for such as result and suggest that insurance providers could include obesity treatments in health plans as a way of keeping older adults in the labor market. However, they provided no cost-effectiveness calculations for such a program.

As outlined in this literature review, researchers attacked the topic of obesity as an economic phenomenon—examining the growth of obesity as a function of technological change and agricultural innovation. Others looked at the effects of obesity on mortality and morbidity, associating obesity with higher mortality and risk of diseases such as cancer and cardiovascular disease. Here, however, the primary interest is the effects of overweight and obesity on the labor market. In short, past research has shown that overweight and obesity has negative effects on the labor market, especially for women. While past research did not find much of a negative effect on the wages of men, it did show that obesity hurts women's wages by about 12%. In short, previous research associates overweight and obesity with outcomes that are "bad"—bad for mortality, bad for disease risks, and bad for labor market outcomes. As will be discussed in the next section, the analysis in this chapter improves on previous research in several ways, including using newer data and including better health variables to better control for conditions that could affect wages, but are not related to weight.

Section IV

This analysis is an extension of the previous literature that examined the effects of weight on income. However, this analysis improves on previous work by using a dataset that can allow health effects to be examined more completely. To the best of my knowledge, no other research on the effects of overweight/obesity on wages has included additional health variables that can affect wages, but are not related to weight. This will assist in more fully isolating the effects of weight on wages.

In addition, the dataset used in this analysis has more detailed occupational variables. Instead of using a generic "blue collar" or "white collar" variable, like in Cawley (2003), the dataset allows the use of several different occupational variables as well as separate industry variables. As a result, interaction between body mass index and occupational and industry variables can occur to examine what effects exist across these variables. It is not apparent that any other research has examined the weight/wage relationship this way.

Dataset

The data used in this analysis is from the 2000 Medical Expenditure Panel Survey (MEPS), administered by the Agency for Healthcare Research and Quality (AHRQ), an agency within the United States Department of Health and Human Services. A set of self-reported data, it is a nationally representative sample of the civilian non-institutionalized population for the calendar year 2000. It provides information on employment, health status, doctors' visits, hospital stays and insurance. MEPS currently has two major components: the Household Component and the Insurance Component. The Household Component provides data from individual households and their members, which is supplemented by data from their medical providers. The Insurance Component is a separate survey of employers that provides data on employer-based health insurance. (www.meps.ahrq.gov). The Household Component (HC) collects data from a sample of families and individuals in selected communities across the United

States, drawn from a nationally representative sub sample of households that participated in the prior year's National Health Interview Survey (conducted by the National Center for Health Statistics) (www.meps.ahrq.gov).

During the household interviews, MEPS collects information for each person in the household on the following: demographic characteristics, health conditions, health status, use of medical services, charges and source of payments, access to care, satisfaction with care, health insurance coverage, income, and employment (www.meps.ahrq.gov).

Nearly all of the work that has been done thus far on the effects of weight on wages utilized the National Longitudinal Survey of Youth (1979). The NLSY is an excellent dataset for examining labor market issues and allows for following subjects over time. However, using the Medical Expenditure Panel Survey would add to the existing literature in several ways:

- The dataset is more recent; the data was first collected in 1996 and yearly thereafter. In addition, unlike the NLSY, this dataset is only beginning to be examined by economists interested in health issues, health care consumption and employment.
- Using this dataset extends the age range of individuals examined in the research. This dataset allows for examination of income for individuals aged 18-65 in 2000, as opposed to focusing only on youth.
- While the dataset is focused on medical expenditures, it includes much more health and disability information than the NLSY and includes more variables on health insurance and healthcare consumption. In addition, the

dataset includes job information, including separate variables on occupation and industry. There are variables on sick time taken from work, doctor's visits and health care coverage. As mentioned earlier, the dataset also allows for controlling for conditions, such as blindness or asthma, which could affect income but are not related to obesity.

This additional information makes for a better rounded analysis of weight on income by controlling for factors that could also affect income.

The MEPS is good for using panel techniques for analyzing medical expenditures and particularly good for analyzing insurance coverage, as it is a two year panel. However, height and weight, which is used to calculate BMI in this chapter's analysis, is only recorded one time, as are the other variables of interest in my regressions. Confidentiality concerns limit geographic and employment information in the dataset. Geographic data is limited to census region and the variables on occupation and industry variables, while included in the MEPS, are not publicly available. Permission to gain access to these data must be granted by AHRQ where the requested variables are merged with the public data set and the researcher must perform analyses in cooperation with AHRQ's Data Center in Rockville, Maryland.

Summary Statistics

This analysis examined 11,614 observations. This final number was arrived at by including only those individuals who were aged 18-65 (the MEPS data include information on children and those over age 65), regardless of employment status or hours worked. After eliminating observations with missing data and eliminating observations with extreme height/weight combinations, which could reflect reporting errors, the original dataset size of around 25,000 was reduced to 11,614[5]. Summary statistics are presented in Table 2.1.

Some things to notice by the summary statistics:

- 52% of the observations are women
- 61% of the observations are white
- 60% of the observations were married
- The average number of years of education is just over 12
- About 38% of the individuals lived in the south, but also note that the south is a fairly large census region[6] and, according to the U.S. Census, about 36% of the U.S. population lives in this census region (U.S Census Bureau 2006).

The most interesting variables are the weight variables. Body Mass Index (BMI), a ratio of weight in kilograms to height in meters squared is calculated to create dummy variables: underweight, normal weight, overweight and obese. The mean value of BMI is 27, which is considered overweight by the Centers for Disease Control and Prevention. Notice the dummy variable overweight: 35% of the observations in this dataset are overweight, or have a BMI from 25 to 29.9. Sixteen percent of the observations represent obese persons, or those who have

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[5] In addition to eliminating observations outside the 18-65 age range, an additional 122 observations were eliminated with years of education less than one year and 249 observations were dropped with family size less than one. Lastly, observations were dropped where BMI was less than 15 or greater than 50.

[6] Northeast: CT, ME, MA, NH, VT, RI, NJ, NY, PA
Midwest: IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, SD
South: DE, DC, FL, GA, MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, TX
West: AZ, CO, ID, MT, NV, NM, UT, WY, AK, CA, HI, OR, WA

a BMI of 30 or higher. Figure 1 graphically presents the BMI distribution for men and women, Figure 2 presents the distribution for men only, and Figure 3 presents the distribution for women. Notice the upper cut off for BMI is 50. This is by design: observations with BMI greater than 50 were eliminated in an effort to exclude observations with height or weight recorded in error. A person who is six feet tall would have a BMI of 25 if they weighed 184 pounds. That person would have a BMI of 50 if they weighed 368 pounds. In total, 51% of the observations in this dataset are over what is recognized as a healthy weight. This is particularly interesting, since 55% of the observations claim to take part in exercise three times a week.

In addition, dummy variables were generated based on the BMI variable. An observation is considered underweight if BMI is less than 18. Normal weight will be indicated by BMI of between 18 and 24.9, and an observation is considered overweight if BMI is between 25 and 29.9. Lastly, an observation is considered obese if BMI is over 30.

Table 2.2 presents summary statistics for observations in each BMI category. A couple of interesting observations about this information:

- The obese category has, on average, the dataset's oldest observations, with a mean age of 42. The underweight category has, on average, the dataset's youngest observations, with a mean age of 33.
- Women make up the majority of the underweight and normal weight categories, with 75% and 61% of the observations, respectively, while men make up most of the overweight category. The obese category is split equally.

Other Notes about Selected Variables

Earnings: Earnings are measured as wage income for 2000. This measure only includes wages from employment and is therefore a better measure of income than total income, since it only includes employment wages and not earnings from sources like unemployment benefits or rental property.

Industry and Occupation Codes: According to the documentation for the Medical Expenditure Panel Survey, these codes were assigned by professional coders based on subject responses to questions about employment. Coding was done based on the 1990 Census classification system. These codes are determined at a detailed three digit system and then collapsed into larger groups in order to ensure confidentiality.

Other Health Variables: In addition to Body Mass Index and the BMI categorical variables, the regressions will also include variables on whether or not the subject takes part in vigorous physical activity at least three times a week and if the subject is a smoker. Additionally, there are variables on cognitive limitations, vision impairment, hearing impairment, stroke, asthma, emphysema, and whether or not the respondent was in better health than they were the year prior to the interview.

Cognitive Limitation: Mitra (2001) and Cawley (2004) both discuss the importance of controlling for some measure of intelligence or cognitive ability in any examination of wages. In the Medical Expenditure Panel Survey, the cognitive limitation variable is based on a three part question indicating if the subject: experiences confusion or memory loss, has problems making decisions, or requires supervision for their own safety. If a “yes” response is given to any of these questions, the person is identified as having a cognitive limitation. For the purposes of this analysis, the cognitive limitation variable equals 1 if the observation has been identified as having a cognitive limitation and 0 otherwise.

Vision Problems: The MEPS screeners asked respondents a series of questions addressing visual problems. The vision impairment variables summarizes these questions and identifies if the subjects: have no difficulty seeing; have some difficulty seeing, can read newsprint, and can recognize familiar people; have some difficulty seeing, cannot read newsprint, cannot recognize familiar people, but are not blind; or is blind. It was not practical to create dummy variables for individual vision problem categories since each category had relatively low numbers of observations.

Therefore, this variable identifies vision problems beyond those that are merely corrected with contacts or glasses. In this paper, the vision impairment variable is equal to 0 if the respondent has been identified as not having any difficulty seeing and 1 if the respondent has been identified as having vision problems matching the other four categories described above.

Hearing Problems: The respondents were asked a series of questions regarding hearing impairment. The hearing impairment variable summarizes responses and identifies whether or not the subject: has no difficulty hearing; has some difficulty hearing, can hear most things people say; has some difficulty hearing, cannot hear most things people say, can hear some things people say;

has some difficulty hearing, cannot hear most things people say, cannot hear some things people say, but is not deaf; or is deaf.

As with the vision problem variable, the hearing impairment variable is equal to 0 if the respondent has no difficulty hearing. It is equal to 1 if the respondent fits into any of the other four categories. Other variables are included that indicate whether the respondent had ever been diagnosed with stroke, asthma, or emphysema.

The data in this paper have been merged with data from the Area Resource File (ARF). According to Quality Resource Systems, Inc., the organization that maintains the Area Resource File is compiled from several resources, including the National Center for Health Statistics, the American Hospital Association, and the American Medical Association. The analyses in this paper include variables from this dataset on county-level unemployment rates for the year 2000 as well as data on median rent, so as to have a proxy for cost of living or area amenities.

Initial Regression Results

The theoretical framework in this analysis is based on the standard wage equation, which can be traced to Jacob Mincer (1974):

$$(1)\ \text{Lnwageincome}_i = \beta_0 + \beta_1 X_i + \varepsilon_i$$

In equation 1, X is a vector of characteristic control variables, including variables on race, education, marital status, dummy variables based on BMI and variables that control for other health issues, including cognitive issues, sight, and hearing, that may affect income but that are not related to weight. Given that past research has pointed to different effects of BMI on wages between men and women, the regression is first run with men and women pooled together, and then regressions are run on each gender separately. Results of these regressions are presented in Table 2.3[7]. All regressions in this analysis are run omitting the "professional" occupational variable and "professional services" industry variable.

Keep in mind that wage income is not positive for all observations, since not all individuals in the survey are employed. To address the underlying decision to work, this analysis uses the Heckman (1979) correction method for self-selection. In the two step method, the first step is a probit equation that predicts the probability that an observation has positive wage, that is, whether the individual made the decision to work[8]. Using the estimates produced from the probit equation, a Mills' ratio is calculated for each observation. The Mills' ratio is then used as a regressor in the wage equations to produce consistent estimates.

Adjustments to the regression coefficients will be needed. When the dependent variable is in log form and the independent variables are linear, the usual interpretation of the coefficient is that, multiplied by 100, it is equal to the percentage effect of that variable on the dependent variable. However, as

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[7] Regressions were also run that included dummy variables based on age range (age 18-24, age 25-35, age 36-45, age 46-55 and age 56-65) in lieu of a continuous age variable. The results were very similar to the regression results included in this chapter and are, therefore, not included here. In a similar vein, an additional analysis was performed comparable to that in Register and Williams (1990), focusing on workers aged 18-25. In that analysis, obese (BMI 30+) men and women suffer similar wage penalties of 6%. Again, this is similar to the analysis in this chapter and these results are not included.

[8] The selection equation contains the following variables: age, age squared, female, years of education, race variables, married, regional variables, BMI categorical variables, other health variables, family size, county median rent and county unemployment rate.

Halvorsen and Palmquist (1980) showed, this is an incorrect interpretation for dummy variables, since they are not continuous. A correction must be performed on the dummy variables in order to make accurate interpretations of the variables' effects on length of stay. The correction takes on the form:

$$(2)\ C=\ln(1+G)$$

In equation 2, C is the coefficient of the dummy variable and G is the actual relative effect on earnings of each of the dummy variables. As mentioned, instead of including body mass index, the regressions include categorical variables based on body mass index[9]. Categorical variables can isolate what happens to income when a person is in a range of body mass index and, if one is thinking about discrimination, it is easier to look at an individual and discern whether they are obese or within a normal weight, rather than determine what the numerical body mass index is. Recall that an individual is considered underweight if BMI is less than 18, of normal weight if BMI is between 18 and 24, overweight if between 24 and 30 and obese if BMI is greater than 30. Again, regressions are run with normal weight as the omitted variable and reported in Table 2.3.

These results are interesting because they appear, in one sense, to contradict previous research. In the regression run only on women, it appears that, relative to women who are within a normal weight range, overweight (BMI 25-30) women experience only a very slight wage penalty (1.8%) and it is not significant by conventional measures. Underweight (BMI less than 18) and

[9] Initially, regressions were performed that included BMI as a continuous variable. However, results of these regressions are not included here because they were not informative.

obese (BMI 30+) women do not experience significant wage penalties relative to normal-weight women, with penalties of 3.5% and 3.8%, respectively, after adjustment. Relative to normal-weight (BMI 18-24) men, obese (BMI 30+) men experience a wage penalty of 3% but, like the coefficients in the regression on women, this is not significant by conventional measures. This is in contrast to Averett and Korenman (1999) and Cawley (2004) that show that overweight (BMI 25-29) women experience wage penalties relative to normal weight (BMI 18-24) women.

In addition, there is the possibility that there is unusual self selection into the labor market by individuals according to weight. Therefore, the first stage probit results for each regression could be of interest. The coefficients from the weight dummy variables included in the first stage probit are also reported in Table 2.3. In the regression with men and women pooled, and in the regression on women only, only the overweight variable in the first stage probit was significant at conventional levels. Overweight women (BMI 25-29) were more likely to be in the labor market. Weight did not affect the likelihood of men being in the labor market.

It is possible that the results are due to the inclusion of better health measures in addition to the weight variables[10]. For comparison purposes, these regressions are performed omitting all health variables aside from the BMI categorical variables. The results are presented in Table 2.4 and indicate that, overall, being merely overweight (BMI 24-29) has no significant effect on wages.

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[10] One note about the coefficients on the health variables. The coefficient on emphysema is not significant in any regression run in this chapter, However, because smoking is also included in the regressions, the lack of significance could be due to some degree of multicollinearity.

Being underweight (BMI less than 18) or obese (BMI 30+) has a depressive, but not significant effect on wages. Furthermore, being underweight (BMI less than 18) had a worse effect on wages. This is true for the separate regressions run on men and women also.

Other Regressions[11]

Overweight Categorical Variable Interacted with Occupational and Industry Variables

An interesting approach to this topic is examining the effect of weight across industries and occupations. If it is the case that discrimination occurs in certain occupations or industries, it is more likely to be uncovered using this approach, for the simple reason that employers and individuals cannot estimate a person's exact body mass index simply by looking at them, but could easily discern whether a person is obese (BMI 30+), or simply overweight (BMI 25-29).

$$(3)\ \text{Lnwageincome}_i=\beta_0 + \beta_1 X_i + \beta_2 \text{Overweight*Industry}_i + \beta_3 \text{Overweight*Occupation}_i + \beta_4 \text{Occupation}_i + \beta_5 \text{Industry}_i + \varepsilon_i$$

As shown in equation 3, the overweight (BMI 24-29) variable is interacted with each industry and occupational variable. With the other regressions, men and women are evaluated together, and then separate regressions are run for each gender. Results are shown in Table 2.5.

[11] Other regressions performed but not included in this analysis involved focusing on smokers and generating a "superobese" variable, that is, one that indicated if a person's BMI was at least 35. These regressions were not included in this analysis because they did not yield interesting results

As with the original regressions, it is good to note the first stage probit results. In these regressions, the overweight (BMI 24-29) variable was positive and significant in the regression with men and women pooled, and in the regression with women only. Overweight women (BMI 24-29) were more likely to be in the labor market.

In the regression run on men and women pooled together, it is interesting to note that only two interaction variables were significant. Those individuals that were overweight (BMI 24-29) in the transportation operative occupations earned about 14% less relative to the professional occupation and clerical workers earned nearly 9% less relative to the professional occupation. For the other occupations and industries, being overweight (BMI 24-29) did not, on average, help or hurt wages significantly. This is particularly interesting for an industry like sales, where one might think weight may make a difference.

In the regression run on men, three categories are significant, and all are negative: the managerial, operative and transportation operative occupational variables. No industry variables were significant by conventional measures. None of the interacted variables were significant in the regression run on women only. This is an interesting result, because it tells us that, on average, being overweight, that is, having a BMI between 25-29, does not significantly hurt women, regardless of industry or occupation.

Obese Categorical Variable Interacted with Occupational and Industry Variables

Next, the obese variable is interacted with each industry and occupational variable as shown in equation 4:

$$(4)\ Lnwageincome_i = \beta_0 + \beta_1 X_i + \beta_2 Obese*Industry_i + \beta_3 Obese*Occupation_i + \beta_4 Occupation_i + \beta_5 Industry_i + \varepsilon_i$$

The results of these regressions are presented in Table 2.6. As with the previous regressions, the professional occupational variable and the professional services industry variable are omitted. In the first stage probit, the underweight (BMI less than 18) and overweight (BMI 24-29) variables were significant in the regression with men and women pooled. Overweight has a positive coefficient, underweight had a negative coefficient. In the regression on men only, the underweight variable was negative and significant. In the regression on women only, the underweight and overweight variables were significant. Underweight women were less likely to be in the labor market and overweight women were more likely to be in the labor market.

In the regression on men and women, three industry and occupational interaction variables were significant. Obese (BMI 30+) individuals working in this occupation earn 10% more relative to the professional category. The sales variable and entertainment variables were the other significant categories, and it is not that surprising that these coefficients are negative, given the orientation to "looks" these industries have. Those who are obese (BMI 30+) and working in the entertainment industry have wages that are about 38% less, after adjustment, relative to the professional category and obese (BMI 30+) individuals working in sales earn about 10.5% less, after adjustment, relative to the professional category.

For men, obese (BMI 30+) individuals in the service industry earned 26% more, after adjustment, relative to the professional services industry. Again, it is the entertainment category that yields the largest result. Obese (BMI 30+) men in this industry earned a 44% less, after adjustment, relative to professional services. For women, sales and entertainment were significant: -.148 and -.33, respectively, after adjustment.

The Endogeneity Issue

While the Heckman correction approach is certainly valid and has been used in the past to connect weight, or “looks” to income, it ignores an important aspect of the relationship: that, while excess weight could have a depressive effect on income, it is certainly possible that the reverse is also true, that socioeconomic status can affect weight.

The effect of socioeconomic status on weight is a topic generally investigated by nutritionists and those in the public health field. Gibson (2003) and Reicks, Randall and Haynes (1994), and Darmon, Ferguson, and Briend (2003), just to name a few, examine the effects of low income on obesity and food consumption. Gibson connects low income to obesity and Reicks, et al and Darmon, et al connect low income to low consumption of healthful foods, like fruits and vegetables. Unfortunately, the Medical Expenditure Panel Survey does not contain variables that could clearly be utilized as instruments.   Therefore, instrumental variables estimation is not performed here.

Several past economic papers have addressed the issue of endogeneity with respect to body mass and wages. Conley and Glauber (2005) address endogeneity bias by using an older sample from the Panel Survey of Income Dynamics. They do sibling-random and fixed effects models and find that a 1% increase in a woman's body mass results in a .6% point decrease in family income and .4 percentage point decrease in occupational prestige measured 13-15 years later. BMI is also associated with a decrease in women's likelihood of marriage, spouse's occupational prestige and spouse's earnings. Men experience no negative effects of body mass on economic outcomes. Age splits show that it is among younger adults where BMI effects are most robust, lending support to the interpretation that it is BMI causing occupational outcomes and not the reverse.

Cawley (2004) again uses the National Longitudinal Survey of Youth to further explore differences across gender, race, and ethnicity in the relationship between weight and wages. In this paper, he addresses the issue of endogeneity using three strategies: using a lagged value of weight, estimating a wage equation after taking differences with another individual (either a same sex sibling or a twin); lastly, he uses variables to serve as instruments in instrumental variables estimation. He finds that, for black men, weight is actually positively correlated with education and intelligence test scores, a result that is opposite for other groups. He attributes unobserved heterogeneity to the results for heavier black women, Hispanic men and women, all of whom earn less than lighter weight members of each group. In contrast, weight appears to lower the wages of white women.

<u>Section V</u>

Concluding Remarks

This paper attempted to examine the effects of weight, particularly overweight (BMI 24-29) and obesity (BMI 30+), on wages. Unlike past research on this topic, the analyses in this paper use data from the 2000 Medical Expenditure Panel Survey, a dataset that has not been exploited by health economists. As mentioned in the beginning, this dataset allows for this inclusion of other health variables that do not relate to weight, but could nevertheless affect earnings, such as hearing and vision impairment. In addition, this dataset also allows for the inclusion of occupation and industry variables, something not done in other research.

The results of the wage equations were interesting because they contradict some existing research on weight and wages, women's wages in particular. Cawley and Register and Williams find that, overall, women are hurt by being overweight, or having a BMI of 25-29. In contrast, this analysis finds that, in general, the wages of women are not depressed directly by excess weight, even women considered obese, or having a BMI of 30 or more.

The more interesting results came when the overweight and obese variables were interacted with each of the occupation and industry variables. It is only here that excess weight has a negative effect on women's income, but only for obese women and only in the sales and entertainment industries.

Rather than answering a question, perhaps this research serves to present more questions on the issue of overweight and obesity and wages. First, past research has presented the idea that overweight and obese individuals may experience wage penalties relative to normal weight counterparts. Pagan and Davila (1997), Register and Williams (1990) and Gortmaker, et al. (1993) all allude to the idea that discrimination may play a part in these wage penalties.

While it is difficult to prove, and certainly more research is needed, but, if 60% of the American public is considered at least overweight, it does not seem entirely plausible that such a large segment of the population is being discriminated against and this research, using 2000 data, does not show that at the overweight experience wage penalties. It does not seem reasonable to use data nearly 25 years old to answer questions to 21st century problems.

One last note: there is no doubt that obesity is associated with a myriad of adverse health conditions, such as diabetes and heart disease. However, given that, in this research, there are virtually no negative effects of overweight on income, one has to ask: is it so bad to be a little overweight? Flegal, et al (2005) asserts that the impact of obesity on mortality may have decreased over time, possibly due to improvements in health care. Therefore, is it unreasonable to think that the impact of obesity on wages has decreased over time? Further research will be needed to thoroughly investigate this question.

While this chapter analyzed the effects of obesity on wages—health economics from a labor market perspective, Chapter 3 takes a different approach. In Chapter 3, health economics is approached from the perspective of hospitals and Medicare. That is, from industrial organization and public economics perspectives.

Table 2.1
Summary Statistics
N=11614

Variable	Mean	Std. Dev	Min	Max
Demographic Variables				
Logwageincome*	9.988837	0.87454	7.0012	12.6561
Age	40.36938	12.5665	18	65
Female	0.524539	0.49942	0	1
White	0.61357	0.48695	0	1
Black	0.139487	0.34647	0	1
Asian	0.027381	0.1632	0	1
American Indian/Eskimo	0.008783	0.09331	0	1
Hispanic	0.224126	0.41702	0	1
Married	0.607284	0.48838	0	1
Years of Education	12.65998	2.95117	1	17
NE	0.151886	0.35806	0	1
Midwest	0.214569	0.41039	0	1
South	0.386516	0.48697	0	1
West	0.247029	0.4313	0	1
Occupational Variables				
Professional	0.136043	0.34285	0	1
Managerial	0.110126	0.31306	0	1
Sales	0.079473	0.27049	0	1
Clerical	0.106251	0.30817	0	1
Craftsman	0.089289	0.28517	0	1
Operative	0.048734	0.21532	0	1
Transportation Operative	0.035474	0.18498	0	1
Service	0.101602	0.30214	0	1
Nonfarm Labor	0.030481	0.17191	0	1
Farm Owner	0.004047	0.06349	0	1
Farm Labor	0.015412	0.12319	0	1
Industry Variables				
Agriculture, Forestry, Fisheries	0.020751	0.14256	0	1
Mining	0.00353	0.05931	0	1
Construction	0.055967	0.22987	0	1
Manufacturing	0.117961	0.32258	0	1
Transportation, Comunications, Utilities	0.053384	0.22481	0	1
Sales Industry	0.140692	0.34772	0	1
Finance, Insurance, Real Est	0.048304	0.21442	0	1
Repair Services	0.055881	0.2297	0	1
Personal Services	0.024453	0.15446	0	1
Entertainment	0.011882	0.10836	0	1
Professional Services	0.187963	0.3907	0	1
Public Administration	0.040813	0.19786	0	1
Health Variables				
Activity Limitation	0.051317	0.22065	0	1
Cognitive Limitation	0.022387	0.14794	0	1
Vision Impairment	0.042363	0.20142	0	1
Hearing Impairment	0.039694	0.19525	0	1
Stroke	0.011107	0.10481	0	1
Asthma	0.087395	0.28242	0	1
Emphysema	0.006974	0.08322	0	1
Anxiety/Depression	0.268727	0.44332	0	1
Better Health Than Last Year	0.188652	0.39125	0	1
Underweight	0.017393	0.13074	0	1
Obese	0.16041	0.367	0	1
Overweight	0.356208	0.4789	0	1
Normal weight	0.361633	0.48049	0	1
BMI	27.16093	5.4953	15.208	49.9172
Physical Activity	0.553901	0.49711	0	1
Smoker	0.245566	0.43044	0	1

*N=9753 for this variable

Table 2.2
Summary Statistics, by BMI category
N=11614

Variable	Underweight	Normal	Overweight	Obese
Demographic Variables	n=202	n=4200	n=4137	n=1863
Logwageincome*	9.708567	9.94642	10.08183	9.9597
Age	33.0198	38.3433	41.56684	42.3446
Female	0.7574257	0.61238	0.413585	0.50081
White	0.6188119	0.66238	0.603094	0.5679
Black	0.1485149	0.11	0.134639	0.17069
Asian	0.0990099	0.04429	0.020788	0.00859
American Indian/Eskimo	0.0148515	0.00571	0.008219	0.01449
Hispanic	0.1287129	0.19	0.247281	0.25228
Married	0.4257426	0.55738	0.649263	0.65164
Years of Education	12.96535	13.0012	12.63476	12.2195
NE	0.2079208	0.165	0.147933	0.12936
Midwest	0.2029703	0.22048	0.219724	0.20505
South	0.3613861	0.36095	0.365966	0.44552
West	0.2277228	0.25357	0.266377	0.22008
Occupational Variables				
Professional	0.1485149	0.15452	0.139957	0.10467
Managerial	0.1089109	0.1119	0.117235	0.09984
Sales	0.0891089	0.08143	0.083394	0.07676
Clerical	0.1534653	0.11762	0.095238	0.09662
Craftsman	0.039604	0.07405	0.113609	0.0891
Operative	0.0346535	0.03976	0.05052	0.06119
Transportation Operative	0.019802	0.02	0.041576	0.04992
Service	0.0792079	0.10024	0.095963	0.11433
Nonfarm Labor	0.019802	0.03024	0.031424	0.03221
Farm Owner	0	0.0031	0.004109	0.00698
Farm Labor	0.019802	0.0119	0.019096	0.01664
Industry Variables				
Agriculture, Forestry, Fisheries	0.0148515	0.01929	0.02103	0.02738
Mining	0.0049505	0.00238	0.003384	0.00483
Construction	0.019802	0.04833	0.066715	0.05958
Manufacturing	0.0841584	0.10048	0.137781	0.11326
Transportation, Comm., Utilities	0.0346535	0.04095	0.063814	0.05797
Sales Industry	0.1485149	0.145	0.14044	0.1401
Finance, Ins., Real Estate	0.0544554	0.05024	0.053179	0.04455
Repair Services	0.0792079	0.05548	0.055354	0.05743
Personal Services	0.0346535	0.02905	0.020788	0.02254
Entertainment	0.029703	0.01333	0.011361	0.01181
Professional Services	0.2029703	0.20929	0.17839	0.16747
Public Administration	0.0148515	0.03429	0.045685	0.04616
Health Variables				
Activity Limitation	0.0544554	0.04024	0.044235	0.06119
Cognitive Limitation	0.029703	0.01952	0.020788	0.02308
Vision Impairment	0.0643564	0.03595	0.037467	0.04724
Hearing Impairment	0.049505	0.02857	0.044477	0.04724
Stroke	0.009901	0.00762	0.009911	0.01396
Asthma	0.0792079	0.07643	0.081943	0.09608
Emphysema	0.019802	0.00667	0.006527	0.00483
Better Health--Last Year?	0.2029703	0.17881	0.195794	0.18304
BMI	17.60082	22.3626	27.18777	32.1322
Physical Activity	0.5594059	0.61833	0.576021	0.46055
Smoker	0.3217822	0.27143	0.247522	0.20129

Figure 1
BMI Frequencies, Men and Women
BMI<18, Underweight
BMI 18-24.9, Normal
BMI 25-29.9, Overweight
BMI >30, Obese

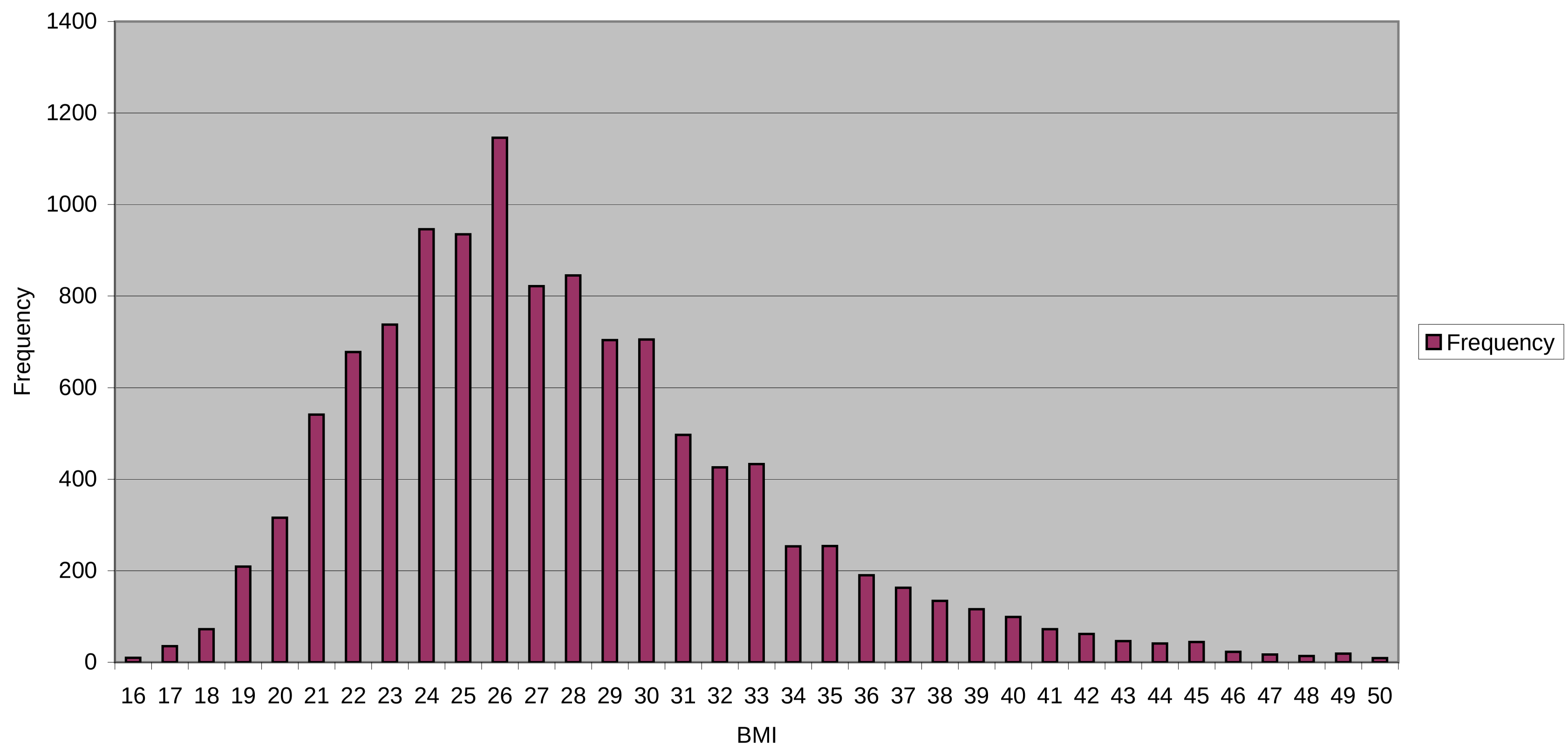

Figure 2
BMI Frequencies, Men Only
BMI<18, Underweight
BMI 18-24.9, Normal
BMI 25-29.9, Overweight
BMI >30, Obese

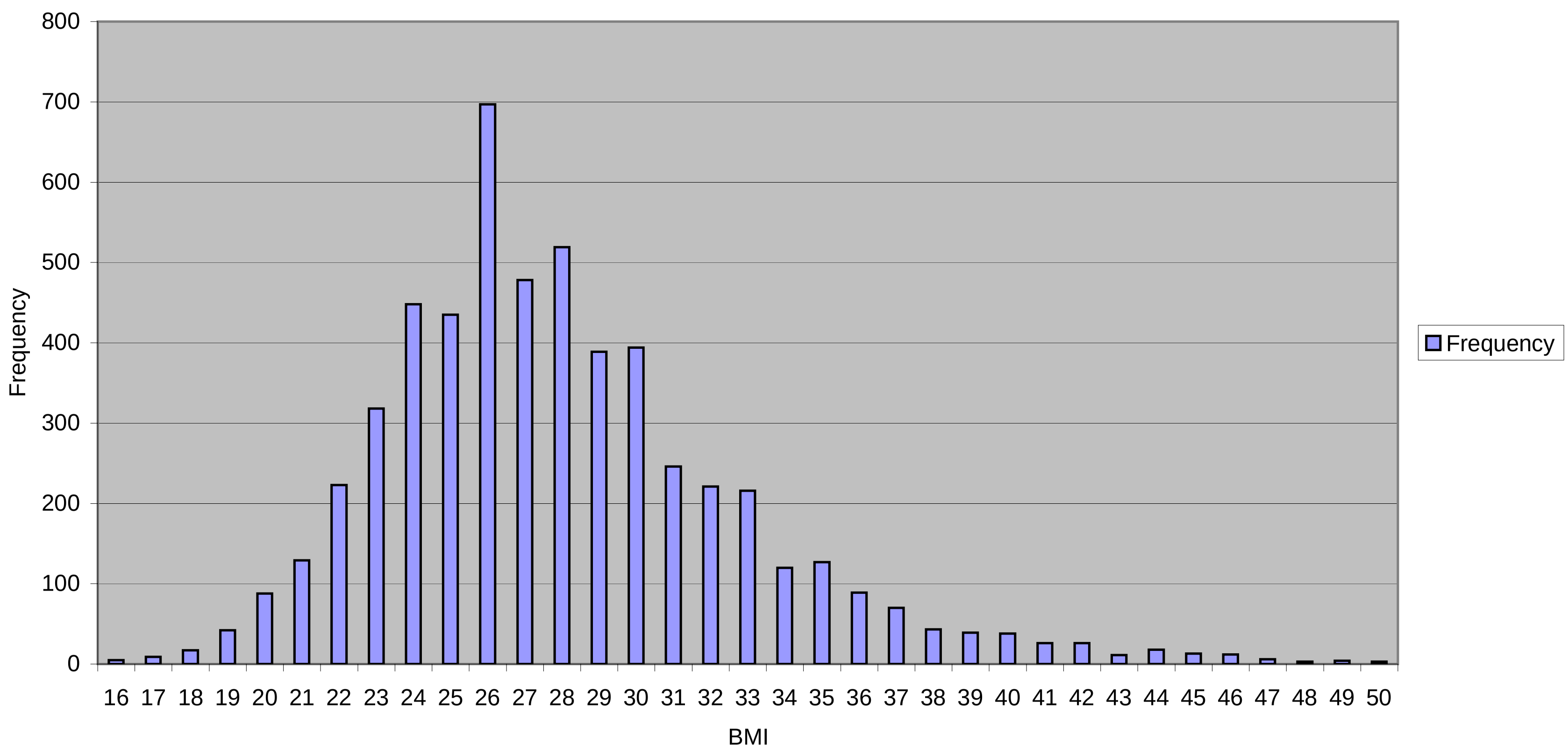

Figure 3
BMI Frequencies, Women Only
BMI<18, Underweight
BMI 18-24.9, Normal
BMI 25-29.9, Overweight
BMI >30, Obese

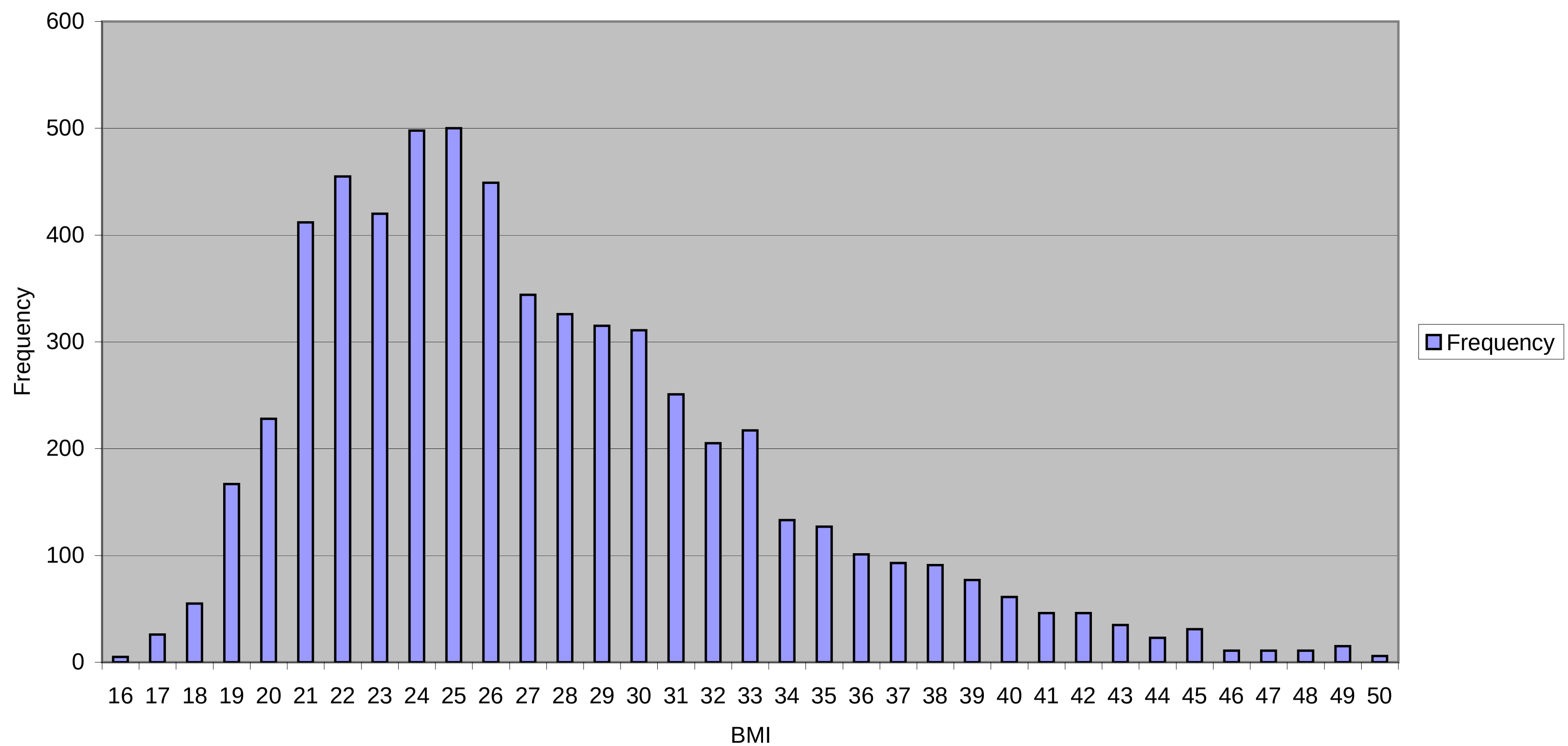

Table 2.3
Heckman Two Step Regression Results
Wage Equation
Dependent Variable: Logwageincome

	Men and Women				Men Only				Women Only			
	Constant=6.289889				*Constant=6.117928*				*Constant=6.475291*			
Variable	Coefficient	Adj. Coeff	Std. Error	t-value	Coefficient	Adj. Coeff.	Std. Error	t-value	Coefficient	Adj. Coeff.	Std. Error	t-value
Demographic Variables												
Age	0.1004548	.	0.0055826	17.99	0.1167395	.	0.007755	15.05	0.08144	.	0.00781	10.43
Age Squared	-0.0010452	.	0.000071	-14.72	-0.0012631	.	9.93E-05	-12.72	-0.000791	.	0.000099	-7.99
Years of Education	0.0817092	.	0.0038318	21.32	0.0743946	.	0.004119	18.06	0.081314	.	0.007066	11.51
Female	-0.1519162	-0.14093973	0.0218553	-6.95								
Black	-0.1222724	-0.11509271	0.0227504	-5.37	-0.1605429	-0.1483187	0.034927	-4.6	-0.088877	-0.085042	0.032819	-2.71
Asian	-0.1657446	-0.1527374	0.0448369	-3.7	-0.1911805	-0.1740165	0.061114	-3.13	-0.126039	-0.118419	0.067699	-1.86
American Indian/Eskimo	-0.1655662	-0.15258624	0.0784244	-2.11	-0.2066847	-0.186724	0.109136	-1.89	-0.165197	-0.152273	0.117228	-1.41
Hispanic	-0.1071328	-0.10159364	0.0212264	-5.05	-0.156602	-0.1449557	0.026949	-5.81	-0.033292	-0.032744	0.034218	-0.97
Married	0.0889998	0.093080438	0.0174886	5.09	0.072343	0.075024	0.023238	3.11	0.166718	0.181421	0.031634	5.27
Midwest	0.0569466	0.05859928	0.024755	2.3	0.0604246	0.0622875	0.032454	1.86	0.041284	0.042148	0.038654	1.07
South	0.0029577	0.002962078	0.0226485	0.13	0.0222031	0.0224514	0.029538	0.75	-0.029652	-0.029216	0.035735	-0.83
West	-0.0548558	-0.05337836	0.0241179	-2.27	-0.0385737	-0.0378392	0.032128	-1.2	-0.065947	-0.06382	0.037222	-1.77
Occupational Variables												
Managerial	0.2674846	0.306673507	0.0261237	10.24	0.2421463	0.2739806	0.036245	6.68	0.288853	0.334895	0.038138	7.57
Sales	0.0694339	0.071901206	0.0332571	2.09	0.1045408	0.1102007	0.047432	2.2	0.038055	0.038788	0.046925	0.81
Clerical	0.0184468	0.018617993	0.0263028	0.7	-0.0197962	-0.0196015	0.049324	-0.4	0.021751	0.021989	0.032809	0.66
Craftsman/Foreman	0.1011348	0.106425778	0.0325163	3.11	0.0668694	0.0691558	0.038377	1.74	0.092123	0.0965	0.078919	1.17
Service	-0.0879832	-0.08422374	0.0273461	-3.22	-0.0842304	-0.0807806	0.044265	-1.9	-0.096943	-0.092393	0.03574	-2.71
Operative	0.0188619	0.019040909	0.0393501	0.48	0.0090024	0.009043	0.048982	0.18	0.001485	0.001486	0.066292	0.02
Transportation Operative	0.0371735	0.037873076	0.0419802	0.89	-0.0194954	-0.0193066	0.047874	-0.41	0.122794	0.130652	0.113263	1.08
Nonfarm Labor	-0.0245039	-0.02420612	0.0435937	-0.56	-0.0736676	-0.0710196	0.051068	-1.44	0.023749	0.024033	0.09002	0.26
Farm Owner	-0.1494185	-0.13879138	0.1279758	-1.17	-0.0582901	-0.0566238	0.148693	-0.39	-0.452478	-0.36395	0.240138	-1.88
Farm Labor	-0.1731166	-0.15896046	0.0825808	-2.1	-0.1718036	-0.1578554	0.095751	-1.79	-0.297327	-0.257199	0.169655	-1.75
Industry Variables												
Agriculture, Forestry, Fisheries	0.2303341	0.259020578	0.0785922	2.93	0.2452398	0.2779277	0.097443	2.52	0.211687	0.23576	0.132065	1.6
Mining	0.7380272	1.091804729	0.110194	6.7	0.7361494	1.0878804	0.118965	6.19	0.849236	1.33786	0.260347	3.26
Construction	0.239712	0.270883083	0.0368726	6.5	0.2923665	0.3395939	0.043767	6.68	0.126851	0.135247	0.098562	1.29
Manufacturing	0.3332008	0.395427472	0.0286246	11.64	0.3703075	0.4481799	0.038178	9.7	0.329098	0.389714	0.04855	6.78
Transportation, Communications, Utilities	0.3334863	0.395825924	0.034554	9.65	0.3980532	0.4889232	0.045394	8.77	0.286467	0.331715	0.057653	4.97
Sales	0.039135	0.039910862	0.0270665	1.45	0.0941779	0.0987552	0.040122	2.35	0.012686	0.012767	0.038011	0.33
Finance/Real Estate	0.2927264	0.340076095	0.0344533	8.5	0.2788717	0.3216378	0.054311	5.13	0.311583	0.365585	0.045327	6.87
Repair Services	0.1627799	0.176777652	0.0319593	5.09	0.233282	0.2627375	0.043037	5.42	0.102581	0.108026	0.049824	2.06
Personal Services	0.0099978	0.010047945	0.0450021	0.22	0.046608	0.0477112	0.083766	0.56	0.016214	0.016346	0.054289	0.3
Entertainment	0.0982089	0.103193218	0.060875	1.61	0.1987946	0.2199314	0.079499	2.5	0.010332	0.010386	0.094106	0.11
Public Administration	0.3274683	0.387451068	0.0353325	9.27	0.3630183	0.4376622	0.051992	6.98	0.301946	0.352488	0.049793	6.06
Health Variables												
Underweight	-0.0508539	-0.04958248	0.0568059	-0.9	-0.0759483	-0.0731359	0.108295	-0.7	-0.035363	-0.034745	0.071354	-0.5
Overweight	0.0100644	0.010115216	0.0163549	0.62	0.0296662	0.0301106	0.021106	1.41	-0.018384	-0.018216	0.026242	-0.7
Obese	-0.0319326	-0.03142814	0.0211273	-1.51	-0.030995	-0.0305196	0.028375	-1.09	-0.039497	-0.038727	0.032723	-1.21
Physical Activity at Least 3 Times a We	-0.0108524	-0.01079373	0.0145595	-0.75	-0.0274044	-0.0270323	0.020023	-1.37	0.013576	0.013668	0.022164	0.61
Smoker	-0.0771757	-0.07427281	0.0171719	-4.49	-0.1011841	-0.0962334	0.022007	-4.6	-0.051293	-0.05	0.027899	-1.84
Cognitive Limitation	-0.1329697	-0.12450838	0.080146	-1.66	-0.2784376	-0.2430345	0.113566	-2.45	0.041855	0.042744	0.113372	0.37
Vision Impairment	-0.0393844	-0.03861892	0.0382714	-1.03	-0.0183466	-0.0181793	0.057044	-0.32	-0.056527	-0.054959	0.05374	-1.05
Hearing Impairment	0.0379079	0.03863557	0.0383291	0.99	0.0520861	0.0534664	0.04432	1.18	0.030197	0.030658	0.073817	0.41
Stroke	-0.0445674	-0.04358886	0.0924378	-0.48	-0.2290623	-0.204721	0.127316	-1.8	0.150245	0.162119	0.13534	1.11
Asthma	0.009179	0.009221256	0.0259898	0.35	0.0400392	0.0408516	0.037432	1.07	-0.01374	-0.013646	0.037598	-0.37
Emphysema	-0.013602	-0.01350991	0.1060098	-0.13	-0.1342514	-0.1256298	0.140651	-0.95	0.065748	0.067957	0.164029	0.4
Geographic Variables												
2000 Median Rent	0.0007297	.	0.0000496	14.71	0.0006798	.	6.55E-05	10.38	0.000764	.	7.73E-05	9.89
First Stage Probit Results												
Underweight	-0.1709662			-1.57	-0.0998557			-0.41	-0.184384		-1.48	
Overweight	0.1485344			4	0.0886683			1.36	0.139864		2.96	
Obese	0.0245097			0.54	-0.0801152			-0.99	0.041845		0.73	
	N=11614				N=5522				N=6092			
	Wald chi2=6050.12				Wald chi2=3264.55				Wald chi2=2839.83			

Table 2.4
Heckman Two Step Regression Results
Wage Equation, Omitting Health Variables
Dependent Variable: Logwageincome

Variable	Men and Women				Men Only				Women Only			
	Constant=6.149846				*Constant=5.826642*				*Constant=6.207484*			
	Coefficient	Adj. Coeff	Std. Error	t-value	Coefficient	Adj. Coeff	Std. Error	t-value	Coefficient	Adj. Coeff	Std. Error	t-value
Demographic Variables												
Age	0.100862	.	0.00564	17.88	0.118661	.	0.00785	15.11	0.08641	.	0.00771	11.21
Age Squared	-0.00106	.	7.5E-05	-14.12	-0.00132	.	0.00011	-12.41	-0.0009	.	0.0001	-8.48
Years of Education	0.086375	.	0.00465	18.56	0.08319	.	0.00483	17.21	0.08913	.	0.00806	11.05
Female	-0.16913	-0.1556	0.02349	-7.2								
Black	-0.10917	-0.1034	0.02304	-4.74	-0.15581	-0.1443	0.03625	-4.3	-0.0814	-0.0782	0.03217	-2.53
Asian	-0.1642	-0.1514	0.04502	-3.65	-0.19305	-0.1756	0.06244	-3.09	-0.1381	-0.129	0.06602	-2.09
American Indian/Eskimo	-0.18063	-0.1653	0.07858	-2.3	-0.24082	-0.214	0.11137	-2.16	-0.1701	-0.1564	0.11416	-1.49
Hispanic	-0.10036	-0.0955	0.02078	-4.83	-0.13645	-0.1276	0.02675	-5.1	-0.0529	-0.0515	0.03307	-1.6
Married	0.100843	0.1061	0.01624	6.21	0.123599	0.13156	0.02701	4.58	0.1416	0.15211	0.02918	4.85
Midwest	0.061054	0.06296	0.02511	2.43	0.073924	0.07672	0.03354	2.2	0.05342	0.05487	0.03791	1.41
South	0.005271	0.00528	0.02288	0.23	0.02477	0.02508	0.03008	0.82	-0.0186	-0.0184	0.03547	-0.52
West	-0.05391	-0.0525	0.02398	-2.25	-0.03656	-0.0359	0.03256	-1.12	-0.0577	-0.056	0.0361	-1.6
Occupational Variables												
Managerial	0.275822	0.31761	0.02626	10.5	0.250366	0.2845	0.03673	6.82	0.29694	0.34574	0.03804	7.81
Sales	0.07759	0.08068	0.03347	2.32	0.111697	0.11817	0.04797	2.33	0.04713	0.04826	0.04705	1
Clerical	0.021892	0.02213	0.02651	0.83	-0.01289	-0.0128	0.04996	-0.26	0.02607	0.02641	0.03292	0.79
Craftsman/Foreman	0.101212	0.10651	0.0327	3.1	0.063991	0.06608	0.03882	1.65	0.09089	0.09515	0.07936	1.15
Service	-0.09246	-0.0883	0.02757	-3.35	-0.09457	-0.0902	0.04465	-2.12	-0.0957	-0.0912	0.03599	-2.66
Operative	0.018472	0.01864	0.03961	0.47	0.005015	0.00503	0.04954	0.1	0.00318	0.00318	0.06687	0.05
Transportation Operative	0.038531	0.03928	0.04223	0.91	-0.01764	-0.0175	0.04838	-0.36	0.12337	0.13131	0.11381	1.08
Nonfarm Labor	-0.02977	-0.0293	0.04389	-0.68	-0.08417	-0.0807	0.05162	-1.63	0.02207	0.02232	0.09104	0.24
Farm Owner	-0.01686	-0.0167	0.12877	-1.25	-0.09431	-0.09	0.15017	-0.63	-0.4246	-0.3459	0.24254	-1.75
Farm Labor	-0.17116	-0.1573	0.08311	-2.06	-0.17824	-0.1633	0.09676	-1.84	-0.2828	-0.2463	0.17063	-1.66
Industry Variables												
Agriculture, Forestry, Fisheries	0.245459	0.27821	0.07909	3.1	0.28059	0.32391	0.09851	2.85	0.20837	0.23166	0.13175	1.58
Mining	0.756604	1.13103	0.11087	6.82	0.769956	1.15967	0.12015	6.41	0.8588	1.36034	0.26652	3.22
Construction	0.245453	0.2782	0.03707	6.62	0.310133	0.36361	0.04427	7.01	0.12428	0.13233	0.09876	1.26
Manufacturing	0.341982	0.40773	0.02878	11.88	0.396486	0.48659	0.03856	10.28	0.33181	0.39349	0.04859	6.83
Transportation, Communications, Utilities	0.343603	0.41002	0.03474	9.89	0.417762	0.51856	0.04591	9.1	0.29782	0.34692	0.05765	5.17
Sales	0.041427	0.0423	0.02724	1.52	0.109467	0.11568	0.04054	2.7	0.01304	0.01313	0.03813	0.34
Finance/Real Estate	0.299017	0.34853	0.03468	8.62	0.300587	0.35065	0.05501	5.46	0.31331	0.36794	0.04537	6.91
Repair Services	0.158423	0.17166	0.03216	4.93	0.237416	0.26797	0.04355	5.45	0.09578	0.10051	0.04993	1.92
Personal Services	0.031276	0.03177	0.04538	0.69	0.083642	0.08724	0.08454	0.99	0.02971	0.03016	0.05476	0.54
Entertainment	0.097947	0.1029	0.06127	1.6	0.201574	0.22333	0.08043	2.51	0.00939	0.00943	0.0946	0.1
Public Administration	0.333471	0.3958	0.03554	9.38	0.39454	0.4837	0.05258	7.5	0.30166	0.3521	0.04981	6.06
Health Variables												
Underweight	-0.06251	-0.0606	0.05717	-1.09	-0.15566	-0.1441	0.11078	-1.41	-0.0412	-0.0403	0.06982	-0.59
Overweight	0.011784	0.01185	0.01679	0.7	0.041985	0.04288	0.02212	1.9	-0.0141	-0.014	0.02583	-0.55
Obese	-0.02727	-0.0269	0.02106	-1.3	-0.01871	-0.0185	0.02866	-0.65	-0.036	-0.0353	0.03177	-1.13
Geographic Variables												
2000 Median Rent	0.000745	.	5.1E-05	14.54	0.000723	.	7E-05	10.38	0.00079	.	7.7E-05	10.25
	N=11614				N=5522				N=6092			
	Wald chi2=5336.52				Wald chi2=2876.50				Wald chi2=2596.36			

Table 2.5

Heckman Two Step Regression Results--Overweight Categorical Variable Interacted with Occupational and Industry Variables

Wage Equation

Dependent Variable: Log Wage Income

Variable	Men and Women				Men Only				Women Only			
	Constant=6.276634				*Constant=6.074275*				*Constant=6.477352*			
	Coefficient	Adj. Coeff.	Std. Error	t-value	Coefficient	Adj. Coeff.	Std. Error	t-value	Coefficient	Adj. Coeff.	Std. Error	t-value
Demographic Variables												
Age	0.1003354	.	0.0055852	17.96	0.1167488	.	0.0077556	15.05	0.0812995	.	0.00782	10.4
Age Squared	-0.001044	.	0.000071	-14.69	-0.001264	.	0.0000993	-12.73	-0.0007895	.	9.9E-05	-7.97
Years of Education	0.0817428	.	0.0038388	21.29	0.0744952	.	0.0041187	18.09	0.0813679	.	,0070713	11.51
Female	-0.150274	-0.1395277	0.0219008	-6.86								
Black	-0.122574	-0.1153596	0.0227511	-5.39	-0.162863	-0.150292	0.0348791	-4.67	-0.0882603	-0.084477	0.03282	-2.69
Asian	-0.16377	-0.1510631	0.0448501	-3.65	-0.179965	-0.1647	0.0611225	-2.94	-0.1256613	-0.118086	0.06776	-1.85
American Indian/Eskimo	-0.162288	-0.1498038	0.078408	-2.07	-0.19606	-0.178037	0.1090461	-1.8	-0.1652013	-0.152277	0.1172	-1.41
Hispanic	-0.108445	-0.1027719	0.0212353	-5.11	-0.15903	-0.147029	0.0269227	-5.91	-0.0322002	-0.031687	0.0343	-0.94
Married	0.0886083	0.09265258	0.0174931	5.07	0.072827	0.075544	0.0232317	3.13	0.1674307	0.1822634	0.03167	5.29
Midwest	0.0561991	0.05780827	0.0247686	2.27	0.0546754	0.056198	0.032467	1.68	0.0405708	0.041405	0.03867	1.05
South	0.002653	0.00265652	0.0226459	0.12	0.0188283	0.019007	0.0295534	0.64	-0.0293249	-0.028899	0.03573	-0.82
West	-0.055567	-0.0540516	0.0241286	-2.3	-0.042008	-0.041138	0.0321304	-1.31	-0.0649913	-0.062924	0.03728	-1.74
Occupational Variables												
Managerial	0.300265	0.35021657	0.0328623	9.14	0.3115131	0.36549	0.0499999	6.23	0.2871671	0.3326469	0.04447	6.46
Sales	0.072555	0.07525194	0.0416665	1.74	0.1618133	0.175641	0.0642399	2.52	0.0170093	0.0171548	0.05558	0.31
Clerical	0.0499938	0.05126458	0.0315909	1.58	-0.01135	-0.011286	0.0639241	-0.18	0.0484765	0.0496707	0.0384	1.26
Craftsman/Foreman	0.1348377	0.14435104	0.0423248	3.19	0.1218056	0.129534	0.0518197	2.35	0.1282362	0.1368215	0.09654	1.33
Service	-0.063205	-0.0612492	0.0331995	-1.9	-0.030231	-0.029779	0.0583247	-0.52	-0.0881844	-0.084408	0.04159	-2.12
Operative	0.0604796	0.06234593	0.0492404	1.23	0.0860127	0.08982	0.0650416	1.32	0.0246201	0.0249257	0.07676	0.32
Transportation Operative	0.1007813	0.10603473	0.0539986	1.87	0.0809773	0.084346	0.0630209	1.28	0.0637676	0.0658447	0.14066	0.45
Nonfarm Labor	0.0027963	0.00280021	0.0544196	0.05	-0.022587	-0.022334	0.0660043	-0.34	0.0269437	0.02731	0.1068	0.25
Farm Owner	-0.038862	-0.0381168	0.157556	-0.25	0.0455019	0.046553	0.1888243	0.24	-0.2403522	-0.213649	0.27514	-0.87
Farm Labor	-0.198636	-0.1801514	0.1055017	-1.88	-0.204756	-0.185154	0.1233461	-1.66	-0.2151566	-0.193585	0.21382	-1.01
Industry Variables										0		
Agriculture, Forestry, Fisheries	0.2004008	0.22189239	0.0944724	2.12	0.2565911	0.292517	0.12192	2.1	0.1322812	0.1414292	0.15104	0.88
Mining	0.6933623	1.00043029	0.1351959	5.13	0.6884782	0.990684	0.1509402	4.56	0.8446007	1.3270484	0.28128	3
Construction	0.2248595	0.25214678	0.0475342	4.73	0.303302	0.354323	0.0588699	5.15	0.0550805	0.0566257	0.11634	0.47
Manufacturing	0.3239915	0.38263555	0.0364902	8.88	0.3718328	0.45039	0.052294	7.11	0.3221901	0.3801471	0.05694	5.66
Transportation, Communications,	0.3235152	0.38197716	0.0443333	7.3	0.4049877	0.499284	0.061769	6.56	0.2851403	0.3299486	0.06919	4.12
Utilities										0		
Sales	0.0316194	0.0321246	0.0333414	0.95	0.1002317	0.105427	0.0532874	1.88	0.0091662	0.0092083	0.04481	0.2
Finance/Real Estate	0.3076392	0.36021014	0.0433507	7.1	0.3558642	0.427414	0.0742673	4.49	0.2959467	0.3443985	0.05449	5.43
Repair Services	0.1548091	0.16743508	0.0394318	3.93	0.2329792	0.262355	0.0572237	4.07	0.1185732	0.1258893	0.0575	2.06
Personal Services	0.0277324	0.02812052	0.0539492	0.51	-0.002619	-0.002615	0.1099418	-0.02	0.0541048	0.0555952	0.06307	0.86
Entertainment	0.0295564	0.02999753	0.0748477	0.39	0.146452	0.157719	0.1060905	1.38	-0.0405033	-0.039694	0.10539	-0.38
Public Administration	0.3088191	0.361816	0.0447179	6.91	0.3816998	0.464772	0.0712369	5.36	0.2662591	0.3050732	0.05938	4.48
Occupational Variables Interacted with Overweight												
Managerial	-0.088143	-0.0843696	0.0536503	-1.64	-0.145317	-0.135252	0.0721219	-2.01	0.0230949	0.0233637	0.0856	0.27
Sales	-0.009955	-0.0099054	0.0688458	-0.14	-0.116744	-0.110187	0.0949055	-1.23	0.0690866	0.071529	0.10341	0.67
Clerical	-0.09443	-0.0901089	0.054813	-1.72	-0.006442	-0.006422	0.1002856	-0.06	-0.0909949	-0.086978	0.07255	-1.25
Craftsman/Foreman	-0.085333	-0.0817932	0.0644018	-1.33	-0.115257	-0.108863	0.0750885	-1.53	-0.0963527	-0.091856	0.16737	-0.58
Service	-0.074548	-0.071837	0.0562142	-1.33	-0.119866	-0.112961	0.0870851	-1.38	-0.032666	-0.032138	0.07702	-0.42
Operative	-0.1109	-0.1049718	0.0796411	-1.39	-0.165572	-0.152591	0.0964276	-1.72	-0.0817358	-0.078485	0.14706	-0.56

Table 2.5 (continued)
Heckman Two Step Regression Results--Overweight Categorical Variable Interacted with Occupational and Industry Variables
Wage Equation
Dependent Variable: Log Wage Income

	Men and Women				Men Only				Women Only			
	Constant=6.276634				*Constant=6.074275*				*Constant=6.477352*			
Occupational Variables Interacted with Overweight	Coefficient	Adj. Coeff.	Std. Error	t-value	Coefficient	Adj. Coeff.	Std. Error	t-value	Coefficient	Adj. Coeff.	Std. Error	t-value
Transportation Operative	-0.158869	-0.1468921	0.0839517	-1.89	-0.229032	-0.204697	0.0946567	-2.42	0.1657898	0.180325	0.23593	0.7
Nonfarm Labor	-0.072388	-0.0698303	0.0885928	-0.82	-0.10727	-0.101716	0.1013236	-1.06	-0.016079	-0.01595	0.1953	-0.08
Farm Owner	-0.333485	-0.2835773	0.269513	-1.24	-0.23967	-0.213113	0.3044253	-0.79	-0.8504004	-0.572756	0.56464	-1.51
Farm Labor	0.0154252	0.01554478	0.1704482	0.09	0.0757449	0.078687	0.1951747	0.39	-0.2512625	-0.222182	0.35403	-0.71
Industry Variables Interacted with Overweight												
Agriculture, Forestry, Fisheries	0.1126203	0.11920689	0.170551	0.66	-0.034067	-0.033493	0.2024096	-0.17	0.3262947	0.3858237	0.32308	1.01
Mining	0.1332417	0.14252611	0.2312043	0.58	0.1209809	0.128603	0.2427066	0.5	0.0308369	0.0313173	0.73504	0.04
Construction	0.0363426	0.03701107	0.0738487	0.49	-0.035296	-0.03468	0.0872927	-0.4	0.2678097	0.3070984	0.22079	1.21
Manufacturing	0.0232807	0.02355381	0.0578414	0.4	-0.012068	-0.011996	0.0757609	-0.16	0.0267332	0.0270937	0.10885	0.25
Transportation, Communications, Utilities	0.0309126	0.03139536	0.0698952	0.44	-0.014413	-0.014309	0.0907807	-0.16	0.0110021	0.0110628	0.12495	0.09
Sales	0.0212042	0.02143061	0.0559526	0.38	-0.023822	-0.023541	0.0808165	-0.29	0.0183779	0.0185478	0.08311	0.22
Finance/Real Estate	-0.034256	-0.0336761	0.0711792	-0.48	-0.16429	-0.151504	0.1085554	-1.51	0.0515918	0.0529458	0.09831	0.52
Repair Services	0.019035	0.01921732	0.0659241	0.29	-0.010403	-0.010349	0.0862842	-0.12	-0.0601403	-0.058368	0.11385	-0.53
Personal Services	-0.062384	-0.0604781	0.0971966	-0.64	0.109643	0.11588	0.1693356	0.65	-0.1427923	-0.133066	0.12235	-1.17
Entertainment	0.2019218	0.22375231	0.1285227	1.57	0.1126942	0.11929	0.160729	0.7	0.2603644	0.2974028	0.2344	1.11
Public Administration	0.0531329	0.05456979	0.0722601	0.74	-0.035322	-0.034705	0.1031862	-0.34	0.1206194	0.1281954	0.10818	1.12
Health Variables												
Physical Activity at Least 3 Times a Week	-0.010621	-0.0105644	0.014675	-0.73	-0.024926	-0.024618	0.0200214	-1.24	0.0106942	0.0107516	0.0222	0.48
Smoker	-0.077465	-0.0745402	0.0171797	-4.51	-0.100357	-0.095486	0.0219996	-4.56	-0.0507846	-0.049517	0.02792	-1.82
Cognitive Limitation	-0.140118	-0.1307444	0.0802259	-1.75	-0.294671	-0.255224	0.1135319	-2.6	0.0488007	0.0500111	0.11347	0.43
Vision Impairment	-0.038835	-0.0380907	0.0382617	-1.01	-0.0161	-0.015971	0.0570368	-0.28	-0.0584109	-0.056738	0.05373	-1.09
Hearing Impairment	0.040164	0.04098148	0.0383345	1.05	0.0536492	0.055114	0.0442992	1.21	0.0353463	0.0359784	0.07388	0.48
Stroke	-0.052122	-0.0507865	0.0924831	-0.56	-0.245608	-0.217771	0.1274554	-1.93	0.1504744	0.1623855	0.13545	1.11
Asthma	0.0106613	0.01071833	0.0259964	0.41	0.041399	0.042268	0.0374142	1.11	-0.0117984	-0.011729	0.03765	-0.31
Emphysema	-0.015898	-0.0157718	0.106124	-0.15	-0.140041	-0.130677	0.1407903	-0.99	0.0570109	0.0586673	0.16427	0.35
Activity Limitation	-0.173313	-0.1591258	0.0803928	-2.16	-0.517523	-0.404005	0.1125265	-4.6	0.1615494	0.1753305	0.1077	1.5
Underweight	-0.04961	-0.0483995	0.0568016	-0.87	-0.069082	-0.06675	0.1082596	-0.64	-0.0365135	-0.035855	0.07136	-0.51
Overweight	0.0520598	0.05343874	0.0311606	1.67	0.1421003	0.152692	0.0463893	3.06	-0.0128329	-0.012751	0.04453	-0.29
Obese	-0.03357	-0.0330128	0.0211617	-1.59	-0.037625	-0.036926	0.028422	-1.32	-0.0392995	-0.038537	0.03274	-1.2
Geographic Variables												
2000 Median Rent	0.0007302	.	0.0000496	14.72	0.0006735	.	0.0000655	10.28	0.0007618	.	7.7E-05	9.84
First Stage Probit Results												
Underweight	-0.170966			-1.57	-0.099856			-0.41	-0.1843836			-1.48
Overweight	0.1485344			4	0.0886683			1.36	0.1398636			2.96
Obese	0.0245097			0.54	-0.080115			-0.99	0.0418451			0.73
	N=11614				N=5522				N=6092			
	Wald chi2=6073.28				Wald chi2=3296.76				Wald chi2=2857.93			

Table 2.6

Heckman Two Step Regression Results--Obese Categorical Variable Interacted with Occupational and Industry Variables

Wage Equation

Dependent Variable: Log Wage Income

	Men and Women				Men Only				Women Only			
	Constant=6.119544				*Constant=6.149075*				*Constant=6.088529*			
Variable	Coefficient	Adj. Coeff.	Std. Error	t-value	Coefficient	Adj. Coeff.	Std. Error	t-value	Coefficient	Adj. Coeff	Std. Error	t-value
Demographic Variables												
Age	0.112996		0.00413	27.38	0.1178389	.	0.00556	21.2	0.10808	.	0.00617	17.52
Age Squared	-0.001191		4.9E-05	-24.18	-0.0012619	.	6.7E-05	-18.99	-0.00111	.	7.4E-05	-15.1
Years of Education	0.076642		0.00479	16	0.0716498	.	0.00455	15.75	0.072775	.	0.00916	7.94
Female	-0.133619	-0.1250764	0.02472	-5.41								
Black	-0.120762	-0.1137555	0.02311	-5.23	-0.1360438	-0.127196	0.03705	-3.67	-0.09793	-0.0933	0.03372	-2.9
Asian	-0.162236	-0.1497597	0.04567	-3.55	-0.1738135	-0.159546	0.06233	-2.79	-0.13291	-0.1245	0.06958	-1.91
American Indian/Eskimo	-0.148954	-0.1383908	0.07971	-1.87	-0.1722727	-0.15825	0.11132	-1.55	-0.16067	-0.1484	0.1208	-1.33
Hispanic	-0.101129	-0.0961833	0.02175	-4.65	-0.1505014	-0.139723	0.02736	-5.5	-0.02969	-0.0293	0.03561	-0.83
Married	0.080274	0.08358425	0.01662	4.83	0.0517067	0.053067	0.02824	1.83	0.155268	0.16797	0.03124	4.97
Midwest	0.054448	0.05595714	0.02507	2.17	0.0515493	0.052901	0.03256	1.58	0.043135	0.04408	0.03956	1.09
South	0.001931	0.00193246	0.0229	0.08	0.0165831	0.016721	0.02964	0.56	-0.02609	-0.0258	0.03653	-0.71
West	-0.061823	-0.0599505	0.02479	-2.49	-0.0516875	-0.050374	0.03295	-1.57	-0.07416	-0.0715	0.03854	-1.92
Occupational Variables												
Managerial	0.25138	0.28579821	0.02916	8.62	0.217617	0.243111	0.0404	5.39	0.278937	0.32172	0.0426	6.55
Sales	0.057478	0.05916239	0.03762	1.53	0.0705131	0.073059	0.05342	1.32	0.036622	0.0373	0.05338	0.69
Clerical	0.007614	0.00764316	0.02953	0.26	-0.0082799	-0.008246	0.05619	-0.15	0.004148	0.00416	0.03699	0.11
Craftsman/Foreman	0.084394	0.08805761	0.03677	2.29	0.0538126	0.055287	0.04315	1.25	0.075882	0.07883	0.08685	0.87
Service	-0.114684	-0.1083523	0.0313	-3.66	-0.1286761	-0.120741	0.04958	-2.6	-0.11558	-0.1092	0.04121	-2.8
Operative	0.033026	0.0335771	0.04568	0.72	0.0241379	0.024432	0.05593	0.43	0.004631	0.00464	0.078	0.06
Transportation Operative	-0.004837	-0.0048248	0.05032	-0.1	-0.0602931	-0.058511	0.05617	-1.07	0.159289	0.17268	0.14296	1.11
Nonfarm Labor	-0.031754	-0.031255	0.0496	-0.64	-0.0685391	-0.066243	0.0579	-1.18	-0.04086	-0.04	0.10069	-0.41
Farm Owner	-0.206607	-0.186661	0.15601	-1.32	-0.0763207	-0.073481	0.18945	-0.4	-0.46336	-0.3708	0.26318	-1.76
Farm Labor	-0.139183	-0.1299314	0.09662	-1.44	-0.09845	-0.093759	0.11202	-0.88	-0.43217	-0.3509	0.19658	-2.2
Industry Variables												
Agriculture, Forestry, Fisheries	0.230095	0.25871958	0.09265	2.48	0.2234014	0.250322	0.11357	1.97	0.257208	0.29331	0.15746	1.63
Mining	0.86691	1.37954692	0.13708	6.32	0.8653626	1.375867	0.15281	5.66	0.893352	1.44331	0.2773	3.22
Construction	0.260324	0.29735049	0.04239	6.14	0.3042867	0.355658	0.04958	6.14	0.21623	0.24139	0.11124	1.94
Manufacturing	0.335583	0.39875604	0.03241	10.35	0.3711145	0.449349	0.04229	8.78	0.332511	0.39446	0.05554	5.99
Transportation, Communications, Utilities	0.328673	0.38912382	0.03969	8.28	0.3801905	0.462563	0.05216	7.29	0.297867	0.34698	0.06424	4.64
Sales	0.066641	0.06891199	0.03097	2.15	0.11124	0.117663	0.04498	2.47	0.055645	0.05722	0.04399	1.27
Finance/Real Estate	0.304239	0.35559246	0.03862	7.88	0.2806821	0.324033	0.06077	4.62	0.330051	0.39104	0.05087	6.49
Repair Services	0.182086	0.19971749	0.03645	5	0.257064	0.293128	0.04802	5.35	0.108689	0.11482	0.05785	1.88
Personal Services	0.0309	0.03138205	0.05143	0.6	0.1044621	0.110113	0.09614	1.09	0.018947	0.01913	0.06218	0.3
Entertainment	0.193894	0.2139676	0.06819	2.84	0.3000802	0.349967	0.08777	3.42	0.095362	0.10006	0.10724	0.89
Public Administration	0.353884	0.42459035	0.04131	8.57	0.4005788	0.492688	0.05904	6.78	0.323522	0.38199	0.0591	5.47
Occupational Variables Interacted with Obese												
Managerial	0.077234	0.0802944	0.05954	1.3	0.1353324	0.144917	0.08629	1.57	0.046824	0.04794	0.08511	0.55
Sales	0.050796	0.05210845	0.07661	0.66	0.1805386	0.197862	0.11338	1.59	0.000805	0.00081	0.10641	0.01
Clerical	0.050298	0.05158432	0.05544	0.91	-0.0137568	-0.013663	0.11467	-0.12	0.073462	0.07623	0.06768	1.09
Craftsman/Foreman	0.064976	0.06713384	0.07308	0.89	0.0696538	0.072137	0.08867	0.79	0.0833	0.08687	0.19333	0.43
Service	0.102045	0.10743364	0.05506	1.85	0.2312267	0.260145	0.1031	2.24	0.064835	0.06698	0.06801	0.95
Operative	-0.038101	-0.0373839	0.08523	-0.45	-0.0349492	-0.034346	0.11071	-0.32	0.00446	0.00447	0.13891	0.03
Transportation Operative	0.124411	0.132481	0.08764	1.42	0.1400803	0.150366	0.10382	1.35	-0.09249	-0.0883	0.2306	-0.4

Table 2.6 (continued)
Heckman Two Step Regression Results--Obese Categorical Variable Interacted with Occupational and Industry Variables
Wage Equation
Dependent Variable: Log Wage Income

	Men and Women				Men Only				Women Only			
	Constant=6.119544				*Constant=6.149075*				*Constant=6.088529*			
Occupational Variables Interacted with Obese	Coefficient	Adj. Coeff.	Std. Error	t-value	Coefficient	Adj. Coeff.	Std. Error	t-value	Coefficient	Adj. Coeff	Std. Error	t-value
Nonfarm Labor	0.03952	0.04031162	0.09853	0.4	0.001331	0.001332	0.11645	0.01	0.30619	0.35824	0.20894	1.47
Farm Owner	0.175475	0.19181219	0.27253	0.64	0.0671992	0.069509	0.3124	0.22	-0.27732	-0.2422	0.79387	-0.35
Farm Labor	-0.128546	-0.1206264	0.18337	-0.7	-0.2520515	-0.222795	0.21233	-1.19	0.539464	0.71509	0.37993	1.42
Industry Variables Interacted with Obese												
Agriculture, Forestry, Fisheries	-0.02744	-0.0270671	0.17469	-0.16	0.0167684	0.01691	0.21829	0.08	-0.16429	-0.1515	0.29181	-0.56
Mining	-0.365371	-0.3060609	0.22957	-1.59	-0.3454694	-0.292112	0.24187	-1.43	-0.26527	-0.233	0.74516	-0.36
Construction	-0.090568	-0.0865877	0.08283	-1.09	-0.0689623	-0.066638	0.09813	-0.7	-0.39936	-0.3292	0.2356	-1.7
Manufacturing	-0.010049	-0.0099987	0.06585	-0.15	-0.0256512	-0.025325	0.08729	-0.29	-0.01271	-0.0126	0.11235	-0.11
Transportation, Communications, Utilities	0.008337	0.00837185	0.07824	0.11	0.0256863	0.026019	0.10054	0.26	-0.03807	-0.0374	0.14471	-0.26
Sales	-0.110966	-0.1050306	0.06089	-1.82	-0.0997042	-0.094895	0.09144	-1.09	-0.15994	-0.1478	0.08583	-1.86
Finance/Real Estate	-0.046739	-0.0456631	0.08417	-0.56	-0.0230812	-0.022817	0.1297	-0.18	-0.0785	-0.0755	0.11176	-0.7
Repair Services	-0.088118	-0.0843467	0.07241	-1.22	-0.1360778	-0.127225	0.09858	-1.38	-0.03072	-0.0303	0.11157	-0.28
Personal Services	-0.065003	-0.0629351	0.10292	-0.63	-0.2601992	-0.229102	0.19035	-1.37	0.023274	0.02355	0.12356	0.19
Entertainment	-0.481419	-0.382094	0.15112	-3.19	-0.5866337	-0.443804	0.20142	-2.91	-0.41095	-0.337	0.2286	-1.8
Public Administration	-0.100246	-0.0953851	0.07718	-1.3	-0.193264	-0.175736	0.11773	-1.64	-0.08608	-0.0825	0.10705	-0.8
Health Variables												
Physical Activity at Least 3 Times a Week	-0.009814	-0.0097663	0.0148	-0.66	-0.0310358	-0.030559	0.02031	-1.53	0.017754	0.01791	0.02293	0.77
Smoker	-0.086657	-0.0830082	0.01781	-4.87	-0.1045742	-0.099292	0.02233	-4.68	-0.06832	-0.066	0.02948	-2.32
Cognitive Limitation	-0.101258	-0.0963004	0.0833	-1.22	-0.2294599	-0.205037	0.11752	-1.95	0.076427	0.07942	0.11808	0.65
Vision Impairment	-0.040843	-0.0400202	0.03877	-1.05	-0.0209343	-0.020717	0.05729	-0.37	-0.0547	-0.0532	0.05519	-0.99
Hearing Impairment	0.049463	0.05070672	0.0391	1.27	0.0595251	0.061332	0.04499	1.32	0.048385	0.04957	0.07588	0.64
Stroke	-0.016106	-0.0159774	0.09488	-0.17	-0.1962709	-0.17821	0.12968	-1.51	0.190387	0.20972	0.1397	1.36
Asthma	0.009499	0.00954466	0.0264	0.36	0.0422055	0.043109	0.03764	1.12	-0.01372	-0.0136	0.03872	-0.35
Emphysema	0.003169	0.00317443	0.10685	0.03	-0.1142973	-0.108007	0.14174	-0.81	0.091647	0.09598	0.16712	0.55
Activity Limitation	-0.090442	-0.0864726	0.09405	-0.96	-0.3649383	-0.305761	0.1341	-2.72	0.237875	0.26855	0.12657	1.88
Underweight	-0.035404	-0.034785	0.05835	-0.61	-0.05521	-0.053714	0.11014	-0.5	-0.01814	-0.018	0.07427	-0.24
Overweight	0.003911	0.00391876	0.01751	0.22	0.0286326	0.029046	0.02233	1.28	-0.02745	-0.0271	0.02817	-0.97
Obese	-0.02958	-0.0291471	0.27233	-1.09	-0.0298898	-0.029448	0.03856	-0.78	-0.03811	-0.0374	0.04002	-0.95
Geographic Variables												
2000 Median Rent	0.000755	.	4.8E-05	15.59	0.0006813	.	6.5E-05	10.5	0.000826	.	7.2E-05	11.53
First Stage Probit Results												
Underweight	-0.260834			-2.43	-0.2608342			-2.43	-0.43982			-1.87
Overweight	0.150796			4.18	0.1507959			4.18	0.092985			1.5
Obese	0.051501			0.5	0.051501			1.16	-0.02865			-0.37
	N=11614				N=5522				N=6092			
	Wald chi2=6542.88				Wald chi2=3511.69				Wald chi2=3017.79			

Chapter 3

An Economic Analysis of the Impact on Health Care of Certain Medicare Provisions of the Balanced Budget Act of 1997

The Balanced Budget Act of 1997 (H.R.2015, Public Law 105-33) set into motion the biggest changes to Medicare, the government health care program for the elderly, since the introduction of prospective payment in the early 1980's. In general, these changes were intended to modernize the program, expand benefits and extend the life of the Medicare trust fund. Only ten years has passed since the passage of the Balanced Budget Act of 1997 (BBA), therefore, the effects of the Medicare changes brought about by this legislation have yet to be fully researched academically. To the best of my knowledge, no published economic research has examined the effects of the Medicare provision of the Balanced Budget Act examined in this paper. This is understandable since adequate data has not been available. However, the time has arrived to start examining certain effects of this landmark legislation. This examination is important because the provisions in this law present financial incentives to the healthcare industry that can alter the care patients receive and the specific patients that various providers care for.

This chapter examines the effects of one of the provisions of the Balanced Budget Act of 1997. Specifically, I intend to examine whether the implementation of the post acute care transfer policy caused the length of stay for patients grouped in certain targeted diagnosis related groups (DRGs) to increase, keeping with the goal of the policy change.

The chapter is organized the following way: Section II will briefly summarize the Medicare program: a brief history, coverage and financing. Section III summarizes relevant literature, Section IV summarizes the motivations behind the Balanced Budget Act of 1997 and the changes brought about by the legislation, highlighting the selected provision I plan to analyze. Section V presents methodologies, data and results, and Section VI concludes.

Section II

In a speech on May 22, 1964, President Lyndon B. Johnson said, “We have the opportunity to move… toward the Great Society that demands an end to poverty and racial injustice to which we are totally committed in our time”. The “Great Society” has come to refer to President Johnson’s programs that attempted to address problems in education, housing, jobs, civil rights, and health care, including Medicare, the health care program for the elderly.

Medicare is the common name of Title XVIII of the Social Security Act part of the Social Security Amendments of 1965. Medicare benefits are extended to most people age 65 and older, persons entitled to Social Security or Railroad Retirement disability cash benefits for at least 2 years, most people with end-stage renal disease, and other non-aged people who elect to pay a premium for coverage by the program.

Medicare consists of three “parts”: Hospital insurance, also known as Part A, Supplementary medical insurance, also known as Part B and Medicare+Choice program, sometimes called Part C. Medicare+Choice was established by the Balanced Budget Act of 1997 and expanded beneficiaries’ options for participation in private-sector health care plans. In order to enroll in Part C, a beneficiary must already be enrolled in Medicare Parts A and B. In 2005, Medicare spending reached $342.0 billion in 2005, growing 9.3 percent compared to 10.3 percent in 2004 (www.cms.hhs.gov). Medicare Part A primarily covers inpatient hospital care. However, Medicare Part A coverage also includes:

- Skilled Nursing Facility care: this is generally covered under Part A only if within 30 days of a hospitalization of three or more days and only if deemed medically necessary. A Skilled Nursing Facility, or SNF, is defined as a certified facility that provides inpatient skilled nursing care and related services to patients who require medical, nursing, or rehabilitative services, but not at the level of care provided by a hospital [www.medicare.gov].
- Home Health Agency care: coverage includes care provided by home health aides.
- Hospice: care provided to terminally ill persons with life expectancies of six months or less and who elect to forgo standard Medicare benefits in favor of hospice care.

Medicare Part B generally covers physician services. Coverage extends to some services provided by chiropractors, podiatrists, dentists and optometrists. Additionally, Part B covers emergency room services and outpatient services, including outpatient surgery and ambulance services.

Services not covered by Medicare include long-term nursing care and other needs such as dentures, eyeglasses, and hearing aids.

On December 8, 2003, President George W. Bush signed into law the Medicare Prescription Drug, Improvement and Modernization Act of 2003. The Act will immediately provide Medicare beneficiaries with discounts on their prescription drugs as well as provide comprehensive Medicare prescription drug coverage effective January 1, 2006. Starting in spring, 2004, Medicare beneficiaries will be able to enroll in a Medicare-approved discount card program (The Discount Card) that offers discounts on their prescription drugs. The Discount Card was intended as a temporary program to provide immediate assistance in lowering prescription drug costs for Medicare beneficiaries during 2004 and 2005.

Medicare Part A is financed primarily through a mandatory payroll deduction, shown as the “FICA” tax on payroll deductions. This tax is 1.45% of earnings collected from the employee and matched by an additional 1.45% of earnings, collected from the employer. Self employed persons are required to pay 2.9% of earnings. Medicare Part B is financed two ways: through premium payments ($93.50 per month in 2007, with about 4% of enrollees with higher incomes paying higher premiums based on income), generally deducted from monthly Social Security checks of those enrolled in Part B, and through contributions from the general revenue of the United States Treasury (www.cms.hhs.gov).

Beneficiaries are responsible for charges not covered by Medicare and for various cost-sharing features of the plans, such as copayments and deductibles. Beneficiaries may choose to pay for these charges through a third party such as private "medigap" insurance purchased by the beneficiary, or by Medicaid, if the person is eligible. Medigap refers to private health insurance that pays for most of the health care service charges not covered under Parts A and B of Medicare (www.cms.hhs.gov).

For hospital care covered under Part A, the beneficiary's payment share includes a one-time deductible at the beginning of each benefit period ($992 in 2007). This is the beneficiary's only cost for up to 60 days of inpatient hospital care. If inpatient care is required beyond 60 days, additional copayments ($248 per day in 2007) are required through the 90th day of a benefit period. Beyond the 90th day, the beneficiary is responsible for an additional copayment of $496 per day. For Part B, the beneficiary's payment share includes one annual deductible (currently $131), the monthly premiums, coinsurance payments for Part B services (20% of the medically allowed charges), and a deductible for blood and payment for any services that are not covered by Medicare (www.cms.hhs.gov).

Before 1983, for Part A, Medicare's payments to hospitals and doctors were made on a "reasonable cost" basis, meaning the payment was based on the actual cost of providing services, and did not include any costs unnecessary in the efficient delivery of services covered by a health insurance program. Since 1983, Medicare payments for most inpatient hospital services have been made under the prospective payment system (PPS). As mentioned earlier, under prospective payment, a specific predetermined amount is paid for each inpatient hospital stay's Diagnosis Related Group (DRG) classification. In some cases, the payment the hospital receives from Medicare is less than the hospital's actual cost for providing the covered inpatient hospital services for the stay and in other cases it is more. In either case, the hospital absorbs the loss or makes a profit. Certain payment adjustments exist for extraordinarily costly inpatient hospital stays, and payments for skilled nursing care and home health care are made under separate prospective payment systems.

Before 1992, for Part B, physicians were paid on the basis of "reasonable charge", initially defined as the lowest of 1) the physician's actual charge, 2) the physician's customary charge, or 3) the prevailing charge for similar services in that locality. Starting in 1992, allowed charges were defined as the lesser of 1) the submitted charges, or 2) the amount determined by a fee schedule based on a relative value scale. Most hospital outpatient services are reimbursed on a prospective payment system, and home health care is reimbursed under the same system as Part A. In short, the Medicare program covered 35.8 million people aged 65 and older in 2005, plus 6.7 million disabled persons (include reference to 2006 annual report).

Section III

Review of Relevant Literature

The Medicare Prospective Payment System has interested researchers since its introduction in 1983. Many studies have been done on the effects of moving from a retrospective ("cost-based") payment system to a prospective payment system[12] For example, Feder, et al (1987) examined changes in Medicare costs as a result of implementation of this system. They show that, in the early 1980's, hospitals paid through the prospective payment had significantly lower increases in Medicare costs and greater decreases in Medicare use than other hospitals not affected by prospective payment at that time. Hodgkin and McGuire (1994) and Shen (2003), looked at prospective payment-induced changes in intensity or quality of care. The model developed by Hodgkin and McGuire suggested an important role for the level of prospective payment, regardless of marginal incentives. Shen found that financial pressures adversely affected health outcomes in the short run, but patient mortality was not affected past one year from the admission date. Ellis and McGuire (1986) developed a model where physicians choose services provided to their patients. They showed that if physicians undervalue benefits to patients relative to hospital profits, the prospective payment system can lead to too few services provided to patients.

Some research has been published that examines the Medicare provisions of the Balanced Budget Act of 1997. While they are mainly descriptive in nature, they are worth mentioning here. Angelelli, et al. (2003), examined how rural hospitals altered their post acute (or, post hospital) and long-term care strategies after the Balanced Budget Act of 1997. The study interviewed 540 rural hospital discharge planners in 1997 and reinterviewed 513 of those

[12]Prospective payment is a system of reimbursement in which Medicare payment is made based on a predetermined amount. The payment for a particular service is generally based on the diagnosis related group for that service.

discharge planners in 2000 in order to describe how rural hospitals formed new and altered organizational strategies during a period of change[13]. The results implied that, after the Balanced Budget Act, rural hospitals increased their reliance on swing beds[14] and relationships with outside health care providers. Spector, Cohen and Pesis-Katz (2004) described the pattern of change in home care use and expenditures before and after 1996. The authors found that, after increasing dramatically between 1978 and 1996, formal home-care use and expenditures fell between 1996 and 1999. The authors stated this was largely due to a decrease in Medicare funding as a result of the Balanced Budget Act. After the passage of the Balanced Budget Act, fewer skilled services were provided to the elderly population and more unskilled services were provided to the nonelderly population. The implication here is the increasing role of state governments in funding home care after the Balanced Budget Act. Like the above mentioned studies, the analysis in this paper aims to examine the effects of modifying an existing payment system.

Section IV
Motivations of the Balanced Budget Act

Over time, one of the biggest motivations of changes to Medicare policy was the pending collapse of Medicare Part A. As mentioned earlier, Part A is financed through "FICA" payroll taxes. However, the fund's annual revenues and

[13] Discharge planning is a process used to decide what a patient needs for a smooth move from one level of care to another, for example, planning a move from a hospital to a nursing home. Discharge planners are generally social workers or some other professional.

[14] A swing bed is defined as a hospital bed that can be used to provide either acute care or long term care.

expenses generally do not coincide, implying that the fund could run out of money. By early 1997, Medicare Part A was forecasted to become insolvent during 2001 (Guterman 2000).

Between 1990 and 1996, Medicare spending was increasing in every area; however, some areas were increasing more than others (Guterman 2000):

- Hospital outpatient services increased by almost 10% annually.
- Payments to skilled nursing facilities increased by 20% annually.
- Payments to home health agencies increased by 30% annually.

Reasons cited for these increases were increased use of home health services and increases in payments for skilled nursing facilities. Despite the concerns about spending increases in these non-hospital areas, hospital inpatient spending was still expected to make up the large proportion of the increase (31%) in Medicare spending between 1996 and 2002 (Guterman 2000).

The impending passage of the Balanced Budget Act and its changes in Medicare payments resulted in opposition from the healthcare industry and also from the industry's allies in Congress. For example, On June 10, 1999, Tom Scully, President and CEO of the Federation of American Health Systems, in testimony before the Senate Finance Committee, claimed the transfer policy in particular was "ill-advised" and fundamentally inconsistent with the essence of the Prospective Payment System. Scully claimed the purpose of the PPS was to reward hospitals for efficient behavior; one indicator of which is shorter hospital stays. Furthermore, the transfer policy is unfair to areas of the country where lengths of stay are shorter than average. When patients are transferred for legitimate purposes, these hospitals are penalized with lower reimbursement because they have better practice patterns and shorter lengths of stay (Federation of American Health Systems, 1999).

As a result of such backlash, Congress passed the Balanced Budget Refinement Act of 1999. The BBRA, as it is known, rolled back many of the provisions set forth in the Balanced Budget Act. A discussion of those provisions affected by this legislation is beyond the scope of this paper, but the provision discussed in this paper was not affected (Medicare Payment Advisory Commission 2000).

Medicare Provisions of the Balanced Budget Act of 1997

In this paper, I plan to focus on the changes to Medicare Part A. Specifically, I intend to examine the effects of implementing of the Post Acute Care Transfer Policy. Information about this provision was obtained by the Centers for Medicare and Medicaid Services (CMS). CMS is the government agency that administers the Medicare and Medicaid programs and, prior to July 1, 2001, was known as the Health Care Financing Administration (HCFA).

Certain Hospital Discharges to Post Acute Care

The Balanced Budget Act instructed the Health Care Financing Administration (now the Centers for Medicare and Medicaid Services) to identify 10 diagnosis related groups (DRGs) to test the feasibility of extending the prospective payment system (PPS) acute care transfer payment policy to post acute settings, such as nursing homes or skilled nursing facilities[15]. Prior to the passage of the Balanced Budget Act, the only inpatient discharges considered transfers for the purposes of reimbursement were those discharged from one hospital and admitted at another hospital the same day. That policy was based on the idea that it was inappropriate to pay a hospital a full DRG payment for less than a complete course of treatment. However, when prospective payment was first implemented, the perception was that hospital care and post acute care, such as home health or skilled nursing facility care, were complementary.

Over time, however, health policy analysts began to rethink this relationship and considered the possibility that health care providers were shifting care away from relatively more expensive inpatient settings to relatively less expensive post acute care settings. Providers facing a fixed payment for services provided have financial incentives to separate the product by billing separately for individual services that were thought to be bundled together. Hospitals may shift some of those services to another setting, referred to as "site of care substitution". For example, a facility may shift diagnostic services, such as laboratory work or X-rays, to an outpatient department or a doctor's office. Also, inpatient costs can be reduced by discharging patients earlier to long-term care, rehabilitation facilities, skilled nursing facilities or home health care, all of which are reimbursed under separate payment systems.

According to the Medicare Payment Advisory Commission (MedPac), the strongest evidence that site of care substitution occurred is that, as of 1999, the

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[15] A diagnosis-related group is defined as a case type that identifies patients with similar conditions and types of care. Currently, there are 495 DRGs in Medicare's Prospective Payment System.

Medicare length of stay had fallen 31% over the previous ten years, while the length of stay for all other patients only fell 18%. Hospitals covered by prospective payment have a strong financial incentive to discharge Medicare patients to a post-acute setting as soon as possible. Since per-case payment is not affected by the discharge, the provider keeps any savings from the shorter stays.

Other trends supporting site substitution according to MedPac (1999) were that: 1) Increases in the volume of various types of post-acute care coincided with the large reduction in the length of stay; 2) the decline in the length of stay has been the greatest for DRG's where the use of post-acute care is most prevalent. Hospitals that operate post-acute care services experienced a larger drop in length of stay than those that do not. It should be stressed that MedPac does not present these observations as the results of thorough economic analysis, but simply as observations documented by MedPac and its predecessor organizations.[16]

Therefore, the Post Acute Care Transfer Policy was implemented to examine whether or not it would be suitable to apply this already existing transfer policy to those DRGs that are generally associated with frequent use of post acute care. The Health Care Financing Administration began by identifying the 20 DRGs with the highest share of post acute care discharges conditional on no fewer than 14,000 cases being discharged to a post acute provider. The 10 pilot

[16] The predecessor organizations were the Prospective Payment Assessment Commission and the Physician Payment Review Commission, which merged in 1997 to become MedPac.

DRGs were then chosen based on volume and percent of discharges occurring early in the hospital stay. Table 3.1 summarizes the 20 DRGs.

After October 1st, 1998, hospitals would not receive the full DRG payment for patients transferred to post acute providers more than one day less than the geometric mean length of stay (GLOS) for that patient's DRG.[17] The main intent was to decrease the financial incentive to prematurely transfer patients from hospitals to acute care settings.

After the Balanced Budget Act, to qualify as a post acute transfer, inpatient admissions to post acute care facilities must occur on the same calendar day as the acute care discharge. Home health transfers must occur within a three day period post-discharge. The payment policy calls for twice the per diem reimbursement rate on the first day of the inpatient acute care stay and the per diem on each following day until the full DRG payment is reached. The payment is equal to (and does not exceed) the full DRG amount when the length of stay of the patient is one day less than the national geometric mean length of stay for that DRG. That is, patients transferred on or after one day below the geometric mean length of stay will generate full DRG payments for the hospital. For 3 of the 10 pilot DRGs, (209, 210 and 211) the payment scheme differed because these DRGs incurred a disproportionate percentage of total costs on the first day of hospitalization. CMS estimated that this lower per diem payment for short stay (1 day less than the geometric mean length of stay) would yield 0.6%

[17] Later in this chapter, these patients will be referred to as "shortstay" patients. The geometric mean length of stay for a given DRG in each fiscal year (FY) is based on an average over all patients grouped into that DRG over the previous FY and is published sometime prior to each FY in the Federal Register.

decrease in per case program payments (MedPac 1999). For example, suppose a patient is grouped into a DRG affected by the Balanced Budget Act. Prior to the Balanced Budget Act, this patient could be admitted to an acute care hospital, discharged to a post acute care facility and the hospital would receive the full DRG payment for the patient, regardless of the length of stay in the hospital. After the passage of the Balanced Budget Act, if the hospital were to discharge the patient after a length of stay that was shorter than the geometric mean length of stay minus one day, then the DRG payment would be less than the full amount. The resulting incentive is for hospitals to increase the lengths of stay for patients grouped into one of the pilot DRGs.

This provision provides an interesting avenue for research, especially since this policy is an experiment. The pilot DRGs were chosen with the idea that it could be extended to other DRG's. To the best of my knowledge, no published academic research has investigated this issue. The Balanced Budget Act required the Health Care Financing Administration (now the Centers for Medicare and Medicaid Services) on the implementation of this policy and its effect on hospital treatment patterns and Medicare expenditures. One year's worth of claims data were used to evaluate the impact of the post acute care transfer payment policy (Gilman, et al. 2000). While no econometric analysis was performed in that report, the authors find that total discharges in the 10 postacute care transfer DRGs fell 10.9 percent between the first half of FY1998 and the first half of FY1999. The number of post acute care transfers fell by 13.4 percent. The overall post acute care transfer rate fell from 63.4 to 61.6 percent, or 2.8 percent. The authors note that the results suggest that hospitals may have opted to provide care for patients that would have been discharged to post acute care. The authors also state that these results should be treated as preliminary given the limited data available at that time. This study has not been updated. The analyses performed here, while relatively simple, represent an analytical improvement over that report. In addition, my post-implementation data extends through all of 2000.

Section V
Data Description

The primary dataset used in this analysis is the Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency of Healthcare Research and Quality (AHRQ). HCUP includes the Nationwide Inpatient Sample (NIS), a sample of inpatient data from approximately 1,000 hospitals. They are publicly available data that are available from 1988-2001 and currently include data from 8 states in 1988 to 33 states in 2001. They contain information on diagnoses, admission and discharge status such as whether the patient was admitted through the emergency room or on a weekend and whether the patient was discharged into post-acute care, to home, or died. Patient demographics and basic hospital characteristics including ownership type, region, teaching status and bed size are also included in the dataset.

Data from 1998-2000 are employed for these analyses. The final sample used in this study includes only patients age 65 and older, listing Medicare as the primary payer, discharged alive, that fall under one of the 20 DRGs considered for or included in the policy. The final sample includes 717,784 observations. Summary statistics are listed in Table 3.2.

Interesting characteristics to note: the average age of the discharged patients is just over 78 years and females represent 62% of the sample. In addition, DRG 209 (Major Joint Limb Reattachment Procedures of Lower Extremity) is the most prevalent diagnosis related group represented here, consisting of 19.2% of the observations. DRG 264 (Skin Graft and/or Debridement for Skin Ulcer or Cellulitis with complications or comorbidities) is the least common DRG, consisting of only .15% of the observations. Eighty-five percent of the patients in the sample are white, 7% black.

The summary statistics also include descriptions of dummy variables used in this research. At a glance, one notes that about 86% of the observations represent patients discharged after October 1st, 1998 and 55% of the observations represent patients grouped into the "pilot" DRGs. Nearly 70% of the observations represent patients transferred to some type of post acute care.

Table 3.3 presents most variables ultimately employed in the analyses.[18] While the variables used in the regressions are relatively simple, they merit some explanation. The dummy variable PostBBA equals 1 if the patient was discharged in the 4th quarter of 1998 (the 4th quarter occurring, of course, after 10/01/98) and anytime during 1999. This variable equals 0 if the patient was discharged during quarters 1-3 of 1998. PilotDRG is a dummy variable which equals 1 if the patient was grouped into one of the "pilot" DRGs and 0 otherwise. PostBBAPilot is an interaction variable between PostBBA and PilotDRG. It

[18]Other dummy variables will be generated as needed later but are not included in this table.

equals 1 if the patient is grouped into a “pilot” DRG and discharged after October 1, 1998 (hence making them “eligible” for the new policy treatment) and 0 otherwise. The other interaction variables are self-explanatory. In addition, dummy variables exist for each race, each hospital bed size, each hospital location/teaching status, each geographic region (based on U.S. Census regions) and each form of hospital control.

While the hospital characteristics appear straightforward, it is worthwhile to briefly explain them. According to HCUP, the organization administering the dataset, the bed categories are specific to the hospital’s location and teaching status. Cut off points were chosen such that approximately one-third of the hospitals in a region and location/teaching combination would be in each bed size category. The bed size categories are shown in Table 3.4. Hospital location is considered urban if the hospital is located in a metropolitan statistical area. Hospitals are considered teaching facilities if it has an American Medical Association-approved residency program, is a member of the Council of Teaching Hospitals (COTH) or has a ratio of full-time equivalent interns and residents to beds of .25 or higher. Since rural teaching hospitals are not common, there are no rural teaching/nonteaching categories. Also, according to HCUP, when there was an appropriate sample of hospitals (as with southern rural, southern urban non-teaching and western urban non-teaching), hospitals were classified as public, non-profit (or voluntary), and for-profit (or proprietary). For other strata (north central rural and western rural) a collapsed category of public versus private was employed with the voluntary and proprietary hospitals combined to form one “private” category. HCUP adds that for all other region and location/teaching status combinations, stratification based on control was not advisable.

Econometric Modeling and Results

Analyses of All Observations Grouped into the 20 DRGs

The policy change to Medicare creates variation in length of stay for patients within DRGs included in the policy over time, before and after the policy implementation. In addition, the policy creates variation between the “pilot” DRGs (that is, those included in the policy and the “other” DRGs (those considered for inclusion, but ultimately left out). As mentioned, this policy change affected Medicare reimbursement for the “pilot” DRGs after 10/01/98. Knowledge of this date, along with the “pilot” and “other” DRGs, allows one to identify “treatment” and “control” groups in order to gauge the effects of extending the Medicare transfer policy to post acute transfer cases. This identification will allow examination of the data (often referred to as a “difference in differences” methodology) similar to that in other studies of public policy.

For example, Gruber (2000) assesses the optimal size of disability insurance programs by investigating the elasticity of labor force participation with respect to generosity of benefits. He accomplishes this by looking at Canada, which operates two disability insurance programs, one for Quebec, and one for the rest of Canada. Gruber uses a “difference-in-difference” estimate to focus on the labor supply effect in the large relative change in benefits in the rest of

Canada relative to Quebec. His results reinforce the idea that there was a response in labor supply to the policy change.

Gruber and Poterba (1994) look at the changes brought about by the Tax Reform Act of 1986. Specifically, they examine the effect of the change in the tax treatment of insurance purchases by self-employed individuals on the demand for health insurance by self-employed persons. They employ a difference-in-difference technique to estimate price effects on insurance demand. They find that an increase in the cost of insurance coverage reduces the probability that a self-employed single person will be insured by 1.8 percentage points.

Yelowitz (1995) used a difference in differences method to help assess the impact of losing public health insurance on labor market decisions of women by examining Medicaid eligibility expansions targeted toward young children. The legislative change examined in this Medicaid study creates three dimensions of variation: in the budget constraints for mothers of different ages within a state, across states and over time. This creates “treatment” and “control” groups to “gauge the effects of moving the income eligibility limit for Medicaid to a higher level”. He finds that increasing the income limit for Medicaid resulted in increases in labor force participation and decreases in AFDC participation among affected women, with large results for women who had ever been married.

As mentioned earlier, the policy change implemented by the Balanced Budget Act targets those patients with length of stay that is less than or equal to the geometric mean length of stay minus one day for their DRG in a fiscal year.

However, it might be useful to first begin with an inclusive analysis of the data to first see if the legislation had effects further reaching than the targeted group.

The first analysis performed here will be simple ordinary least squares (OLS) which regresses length of stay on exogenous variables, which includes dummy variables indicating “pilot” DRG status and whether or not the discharge took place after 10/01/98 (PostBBA).

A simple OLS regression may take on the following form:

$$(1)\ LOS_{ih} = \beta_0 + \beta_1 Individual_i + \beta_2 Hospital_h + \beta_3\, PilotDRG + \beta_4 PostBBA + \beta_5 (PostBBA{*}PilotDRG) + \varepsilon_{ih}$$

In this regression, “Individual” represents patient characteristics such as gender, age, race, etc. “Hospital” represents hospital characteristics, such as ownership structure, region, etc. As mentioned, dummy variables are included for PilotDRG (=1 if the patient’s DRG is among the “pilot” DRG’s affected by the policy change), PostBBA (=1 indicates the discharge occurred on or after 10/01/98), and a term which interacts those variables (PostBBA*PilotDRG), since “eligibility” for this policy varies by DRG and time. The interaction equals 1 if the patient was assigned one of the 10 “pilot” DRGs and was discharged on or after 10/01/98 and equals 0 otherwise.

One should ask whether or not it is necessary to take into account the effects of possible anticipation of the policy or any lag effects on the part of hospitals in their response to the policy after its implementation. The following is proposed: because the Balanced Budget Act was signed into law over a year before the provision was to go into effect, hospitals should have had full knowledge of the provision. One could argue that, if hospitals were engaging in behavior such that patients were being transferred “too early” for the purpose of financial gain, there would be no reason for them to alter their behavior before the provision went into effect. In fact, it seems reasonable to expect this behavior to continue as long as possible, until the incentive to do so is taken away. In this case, the incentive to transfer patients early would end 10/01/98. On and after this date, discharges would be subject to the new policy, and any financial incentive to discharge patients early would be gone[19].

The results of the initial regression are presented in Table 3.5. Note that the regression is run relative to a white male, discharged from a medium-sized, urban, non-teaching, private for-profit hospital in the northeast. As can be seen, nearly all the variables are statistically significant at conventional levels. The length of stay for females is, on average, .60 days less than males. Hispanics, blacks, Asians and those categorizing themselves into the other racial category all, on average, have lengths of stay that are longer relative to whites. This is not entirely surprising, since this can reflect a poorer health status of minorities. Relative to the northeast, patients in all other regions of the country have significantly shorter lengths of stay. This might not be unexpected since there could exist relatively more hospitals, especially in the south and certain areas of the west, that are more dependent on programs like Medicare and are more sensitive to financial incentives presented by such programs. All hospital control types were statistically significant with decreased lengths of stay relative to the omitted category, private, for-profit hospitals. One explanation for the positive

[19]To be thorough, however, the issue of timing is addressed later in the chapter.

sign on Large Hospital is that more complicated cases are routed to larger, rather than smaller facilities. Age accounted for an insignificant slight decline in length of stay.

Because the intent is to examine the Post Acute Care Transfer policy on length of stay, PostBBA, Pilot DRG and PostBBAPilot are the main variables of interest here. However, the results yielded here are not entirely expected. The PostBBA coefficient, .0605915 tells us that being discharged on or after 10/01/98 is associated, on average, with only a very slight increase in length of stay for all 20 DRGs considered for this policy, regardless of patient LOS and transfer status. However, it is not significant by conventional measures. The large PilotDRG coefficient, -1.509, is statistically significant and tells us that discharges grouped into one of the 10 pilot DRGs is associated, on average, with a length of stay of about a day and a half less than the non-Pilot DRGs. This might not be entirely unexpected, since nine months of the data come from before the implementation date of the policy. The coefficient could reflect shorter stays before the policy change. The interaction variable, PostBBAPilot (which equals 1 if the patient was grouped into one of the pilot DRGs and discharged after 10/01/98) was statistically significant at conventional levels, but still fairly small, .301, implying that patients in "pilot" DRGs discharged after 10/01/98 had very small increases in length of stay—less than a half a day, on average—relative to other patients. This is expected, given the goal of the policy. That is, it would be expected that this interaction would have a positive and significant coefficient, reflecting the idea that hospitals would no longer have the financial incentive to discharge patients early who were grouped into the 10 “pilot” DRGs.

Because of the relatively small magnitude of the PostBBAPilot variable in the initial regression, a natural next step is to investigate whether or not there were any changes in length of stay associated with any of the individual DRGs. Therefore, another OLS regression is performed. Dummy variables are generated for each of the 20 DRGs and then each of these dummy variables are interacted with the PostBBA variable to arrive at an estimate of the change in length of stay after 10/01/98 associated with DRG i. The regression now takes on the following form:

$$(2)\ LOS_{ih} = \beta_0 + \beta_1 Individual_i + \beta_2 Hospital_h + \beta_3 DRG_i + \beta_4 PostBBA + \beta_5(PostBBA*DRGi) + \varepsilon_{ih}$$

By including each of the DRG variables, it can be determined whether or not there was any change in length of stay for patients grouped in the individual DRGs, rather than looking at an average over all DRGs. Perhaps there was no change for some DRGs and significant changes for others, which is reasonable given the heterogeneity of the diagnosis groups. The results of this regression are contained in Table 3.6 and the regression, as before, is performed relative to a white male, staying at a medium-sized, urban, non-teaching, private for-profit hospital in the northeast. Among the pilot DRGs, DRG 14 (specific cerebrovascular disorders except transient ischemic attack) is omitted and among the non-pilot DRGs, DRG 1 (craniotomy, >17, excluding trauma) is omitted.

Again, the variables of most interest are the interaction variables. One would expect the coefficients on the pilot DRG interaction variables to be positive, reflecting increased lengths of stay relative to the control group, since the policy's goal was to keep hospitals from discharging patients "too early" to post acute care.

This regression yields some interesting, but again unexpected, results. Overall, there does not appear to be evidence that hospitals significantly increased length of stay over *all* pilot DRGs after 10/01/98. In fact, in some cases, it was quite the opposite. For pilot DRGs 209, major joint limb reattachment procedures of the lower extremity, and 236, fractures of hip and pelvis, coefficients were negative and statistically significant at conventional levels, indicating that for patients grouped in these DRGs and discharged after 10/01/98, lengths of stay actually declined relative to DRG 14, specific cerebrovascular disorders except transient ischemic attack.. Other pilot DRGs did experience some increase in length of stay: 113, amputation for circulatory system disorders excluding upper limb and toe; 210, hip and femur procedures except major joint age>17, with complications; 263, skin graft and/or debridement for skin ulcer or cellulitis with complications; and 483, tracheostomy except for face, mouth and neck diagnosis. Being discharged after 10/01/98 made no significant difference at all for DRGs 211, hip and femur procedures except major joint age>17 without complications; 264, skin graft and/or debridement for skin ulcer or cellulites without complications, and 429, organic disturbances and mental retardation. Therefore, one could conclude at this point that there may be other factors affecting length of stay other than financial incentives, such as the nature of the patient's disease and technology. This should certainly be examined further.

One important note about the previous analyses is that it does not control for transfer status. Since this provision of the Balanced Budget Act is aimed at transfer patients, an analysis must be performed that separates out transfer patients from non-transfer patients. This should provide a better idea of just what happened after the Balanced Budget Act provision went into effect. Another OLS regression is performed, taking on the form:

$$(3)\ LOS_{ih} = \beta_0 + \beta_1 Individual_i + \beta_2 Hospital_h + \beta_3 Transfer_i + \beta_4 PostBBA + \beta_5 PilotDRG + \beta_6 PostBBAPilotTransfer + \varepsilon_{ih}$$

For this regression, two new variables are generated: Transfer equals 1 if the patient (regardless of DRG or discharge date) was transferred to post-acute care. PostBBAPilotTransfer equals 1 if the observation represents a patient transferred to post acute care after 10/01/98 and was grouped into one of the 10 "pilot" DRGs. An observation is considered a transfer patient if the patient was discharged to a short-term hospital, skilled nursing facility, intermediate care or some other type of facility. The regression results are contained in Table 3.7.

Again, the regression yields unexpected results. The primary variables of interest are Transfer, PostBBA, PilotDRG, and PostBBAPilotTransfer. The coefficients are all statistically significant and show, on average, that transfer patients stayed 2.62 days longer than non-transfer patients, over all DRGs and discharge dates. Patients discharged after 10/01/98, on average, stayed in the hospital only .50 days longer than other patients, over all DRGs. Patients categorized into one of the ten pilot DRGs had, on average, lengths of stay that were 1.38 less than other patients, regardless of discharge date or transfer status. The coefficient on PostBBAPilotTransfer is expected to be positive, since the aim of the policy is to keep patients grouped into the pilot DRGs from being transferred prematurely to post acute care. However, this coefficient is -.63, indicating that these patients discharged to post-acute care after 10/01/98 actually were in the hospital about a half day less relative to other patients in the sample.

As with the previous regressions, this result raises the question as to how length of stay for transfer patients grouped into the individual DRGs changed, if at all. Therefore an additional OLS regression is performed of the following form:

$$(4)\ LOS_{ih} = \beta_0 + \beta_1 Individual_i + \beta_2 Hospital_h + \beta_3 DRG_i + \beta_4 PostBBA + \beta_5 Transfer + \beta_6 PostBBADRGiTransfer + \varepsilon_{ih}$$

Here, PostBBADRGiTransfer is an interaction term that equals 1 if the patient was grouped into DRG i and transferred to post acute care after 10/01/98. A variable is generated for all 20 DRGs, with the interacted variables for DRGs 14 and 1 omitted from the regression to prevent the dummy variable trap, that is, an exact linear relationship between the dummy variables and the intercept (Kennedy 1998). Results are presented in Table 3.8.

All coefficients on the pilot DRG interaction variables are statistically significant at conventional levels. As with the earlier regression, not all of the patients grouped into pilot DRGs experienced increases in length of stay. In fact, patients grouped into DRGs 113, 209, 210, 211, 236, 264 and 429 experienced decreases in length of stay. On the other hand, DRGs 263 and 483 experienced increases in length of stay. As noted earlier, if hospitals were prematurely transferring patients only for financial gain prior to the effective date of the Balanced Budget Act provision, it is expected that the pilot DRG interaction variables' coefficients would be positive, indicating longer lengths of stay relative to the control group. However, it is not entirely clear at this point why some coefficients are positive and others negative. The positive coefficients on DRGs 263 and 483 could reflect the more complicated nature of those DRGs. DRG 483, tracheostomy except for face, mouth and neck diagnosis is often the highest total cost DRG for hospitals because it involves critically ill patients that require prolonged mechanical ventilation and use significant intensive care resources (Van Boerum, et al. 1999). DRG 263, skin graft and/or debridement for skin ulcer or cellulitis with complications is a DRG that can be associated with patients with conditions such as diabetes, with the phrase "with complications" distinguishing it from the similar DRG 264, skin graft and/or debridement for skin ulcer or cellulitis without complications .

To complement the analysis of the change in length of stay for transfer patients, I reran the regressions as specified by equations (1) and (2) conditional on the patient being transferred to post acute care. Results are presented in Tables 3.9 and 3.10.

Running equation (1) conditional on the patient's transfer status does yield the expected results with regards to the PostBBAPilot and PostBBA variables.

The PostBBAPilot variable is statistically significant and the PostBBA variable is small, positive and significant. The interaction variable is very small, but it is significant. The regression is then performed using DRG interaction variables, as in equation (2), conditional on the patients' transfer status and is presented in Table XIV. The interaction variables for DRGs 113, 263, and 483 are positive and significant, while the variables for DRGs 209 and 236 are negative and significant.

To enhance this analysis, it would be interesting to be able to estimate elasticities in order to see the effects changes in the independent variable on LOS. In this case, we can employ a semilog model of the form:

$$(5)\ \ln LOS_{ih} = \beta_0 + \beta_1 Individual_i + \beta_2 Hospital_h + \beta_3\, PilotDRG + \beta_4 PostBBA + \beta_5 (PostBBA*PilotDRG) + \varepsilon_{ih}$$

Of course, this is referred to as a semi-log model because only the regressand (LOS) is in logarithmic form. Otherwise, the regression follows the same form as equation (1).

When the dependent variable is in log form and the independent variables are linear, the usual interpretation of the coefficient is that, multiplied by 100, it is equal to the percentage effect of that variable on the dependent variable. However, as Halvorsen and Palmquist (1980) showed, this is an incorrect interpretation for dummy variables, since they are not continuous. A correction must be performed on the dummy variables in order to make accurate interpretations of the variables' effects on length of stay. The correction takes on the form:

$$C=\ln(1+G)$$

Here, C is the coefficient of the dummy variable and G is the actual relative effect on LOS of each of the dummy variables. Regression results are presented in Table 3.11, with Table 3.12 containing correct interpretations of the dummy variable coefficients

Addressing first the patient characteristics, one sees that the race variables have the greatest percentage influence on length of stay. As with earlier analyses, this is not surprising, since it could reflect the generally poorer health status of minorities. Among hospital characteristics, the regional variables contribute the largest changes. Again, this could represent regional variation in hospitals' dependence on Medicare.

Among our variables of interest, being grouped into a pilot DRG—regardless of LOS, transfer status or date of discharge—is associated with a nearly 20% decrease in LOS. On the other hand, being discharged after 10/01/98 is only associated, on average, with a 1% decrease in LOS. Discharges grouped into pilot DRGs after 10/01/98 is only associated with an average increase in LOS of less than 5%, however, this result is expected given the aim of the policy.

The issue of timing was previously addressed. It was stated that, since the Balanced Budget Act presented health care providers with an effective date for the policy change, that it is not likely that providers would have any incentive to change behavior until that date. However, it would be a good idea to address the possibility that it may have taken providers longer than 10/01/98 to adjust their behavior.

To do this, two new dummy variables are generated. Lagpostbba equals 1 if the discharge occurred anytime in 1999. This effectively extends the pre-Balanced Budget Act period through all of 1998. Lagpostbbapilotdrg is simply the interaction between lagpostbba and pilotdrg. The regression now takes on the form:

$$(6)\ LOS_{ih} = \beta_0 + \beta_1 Individual_i + \beta_2 Hospital_h + \beta_3 PilotDRG_i + \beta_4 LagPostBBA_i + \beta_5 LagPostBBAPilotdrg_i + \varepsilon_{ih}$$

Results are presented in Table 3.13. Discharges occurring on or after 1/01/99 still have lengths of stay that, on average, were only slightly more compared to the pre-BBA period. The coefficient on lagpostbbapilotdrg is significant but still relatively small.

For completeness, I extend the idea of a “lag period” to the regression originally represented by equation (2). That is, include the individual DRG dummy variables, this time interacting each with the lagpostbba variable. This regression now takes the following form (with results in Table 3.14):

$$(7)\ LOS_{ih} = \beta_0 + \beta_1 Individual_i + \beta_2 Hospital_h + \beta_3 LagPostBBA + \beta_4 DRGi + \beta_3 (LagPostBBADRGi)_i + \varepsilon_{ih}$$

Again, the purpose is to see if I can identify any “lag effect” associated with any of the individual DRGs and one can see that redefining the pre/post BBA period has little effect on the coefficients. Compared to the regression in Table 3.6, there is no change in the coefficients’ signs, and little difference in the coefficients’ magnitudes.

Lastly, the idea of a "lag period" is extended to the regressions that control for transfer status, originally represented by equations (3) and (4), with results originally shown in Tables 3.7 and 3.8. These regressions are now in the following forms:

$$(8)\ LOS_{ih} = \beta_0 + \beta_1 Individual_i + \beta_2 Hospital_h + \beta_3 Transfer_i + \beta_4 PilotDRG + \beta_5 LagPostBBA + \beta_5 (LagPostBBAPilotTransfer)_i + \varepsilon_{ih}$$

$$(9)\ LOS_{ih} = \beta_0 + \beta_1 Individual_i + \beta_2 Hospital_h + \beta_3 LagPostBBA + \beta_4 Transfer + \beta_5 DRGi + \beta_3 (LagPostBBADRG_i Transfer)_i + \varepsilon_{ih}$$

The results of equation (8) are presented in Table 3.15. As with the other "lag" regressions, little has changed relative to the original regression in Table 3.7. The signs of the transfer dummy variables have not changed, and there has been minimal change in the coefficients' magnitudes. The same holds true for the regression represented by equation (9). Shown in Table 3.16, signs did not change relative to the regression in Table 3.8 and there were only slight changes in magnitude.

On the other hand, it is possible that hospitals anticipated the law and did not want to appear to be exploiting the loophole presented by the previous payment system. Therefore, the pre- and post-BBA periods are again redefined. A new dummy variable is generated, AnticipateBBA, that equals 1 if the discharge occurred on or after June 1, 1998, effectively shortening the pre-BBA period a whole quarter before the legislation went into effect. Similar to the above analysis, AnticipateBBAPilotDRG is the interaction between AnticipateBBA and PilotDRG. The regression is of the following form:

$$(10)\ LOS_{ih} = \beta_0 + \beta_1 Individual_i + \beta_2 Hospital_h + \beta_3 PilotDRG + \beta_4 AnticipateBBA + \beta_5 AnticipateBBAPilotdrg + \varepsilon_{ih}$$

Results are presented in Table 2.17. Those patients discharged after June 1, 1998 had, on average, a .05 day shorter hospital stay than other patients, however, this coefficient was not significant by conventional standards. While the coefficient has changed relative to the analogous dummy variable in Table 3.5, the magnitudes of each are small, so it is difficult to tell if there's any real difference between the two. Consistent with other regressions, PilotDRG has a negative coefficient. Those patients discharged after June 1, 1998 and who fall into one of the pilot DRG categories had lengths of stay that were, on average, .35 days longer than other patients.

Again, this idea is extended to a regression that includes individual DRG dummy variables interacted with the AnticipateBBA variable:

$$(11)\ LOS_{ih} = \beta_0 + \beta_1 Individual_i + \beta_2 Hospital_h + \beta_3\ AnticipateBBA + \beta_4 DRGi + \beta_5 (AnticipateBBADRGi)_i + \varepsilon_{ih}$$

Results are presented in Table 3.18. Once again, redefining the pre/post-BBA period does not make much difference in the coefficients. Finally, the idea of "anticipating" the BBA is extended to the regressions that control for transfer status. Like the "lag" regressions, these will basically follow equations (3) and (4):

$$(12)\ LOS_{ih} = \beta_0 + \beta_1 Individual_i + \beta_2 Hospital_h + \beta_3 Transfer_i + \beta_4 AnticipateBBA_i\ \beta_5 PilotDRG_i + \beta_6 (AnticipateBBAPilotTransfer)_i + \varepsilon_{ih}$$

$$(13)\ LOS_{ih} = \beta_0 + \beta_1 Individual_i + \beta_2 Hospital_h + \beta_3 Transfer + \beta_4\ DRG_i + \beta_5(AnticipateBBADRG_i Transfer)_i + {}_{ih}$$

Results are shown in Tables 3.19 and 3.20, respectively. The results of equation (12) are consistent with other results in this paper. Those patients transferred to post-acute care on or after 6/01/98 and categorized into a pilot DRG had lengths of stay that were, on average, .75 of a day shorter than other patients. In equation 13, almost all of the DRG dummies had coefficients that were different, at least in magnitude, from those in the analogous "lag" regression and the original regression represented by equation (4), but there were no changes in signs. These results seem to confirm my initial assertion that, since health care providers knew about the BBA provision a year in advance and knew its effective date, the incentive existed to change behavior when the provision went into effect, not after and not before.

Analysis of "Shortstay" Patients

Thus far, I have investigated the LOS for *all* patients. However, the policy specifically targets those lengths of stay that are at least 1 day less than the geometric mean length of stay for that DRG in a fiscal year (which, for the federal government, begins October 1). The dataset used in this study, thus far, contains information from four different fiscal years: 1998, 1999, 2000 and 2001. Therefore, each DRG will have four different geometric mean lengths of stay. The pilot and nonpilot DRGs are shown in Table 3.21, along with the corresponding length of stay.

A new dummy variable is generated, Shortstay, which equals one if the patient has a length of stay that is less than or equal to the geometric mean length of stay for that DRG in a given fiscal year. The geometric mean length of stay for each DRG is based on the previous year's lengths of stay and is published in the Federal Register sometime prior to the beginning of each fiscal year. It makes sense to narrow the sample to observations that are less than their geometric mean length of stay, since the policy specifically targets those patients with particularly short hospital visits.

The regression shown in equation 3 is rerun. One regression is run with Pilotdrg=1 and then another one is run with Pilotdrg=0. Both are also conditional on Shortstay=1. Table 3.22 presents results, with differences. Again, the primary variables of interest are the Transfer, Postbba and Postbbatransfer variables. When PilotDRG=1, only the transfer variable has a significant coefficient. In this regression, transfer patients experienced an increase in length of stay of nearly a day (.86) relative to non-transfer patients, over all time periods. Those patients discharged after 10/01/98, on average, experienced decreases of length of stay of about .06. The interaction variable showed an average increase of .03 day for these patients, but was not significant by conventional measures. This result does not support the idea that, if acute care hospitals were simply exploiting a financial loophole with regards to transfer patients, behavior would change after 10/01/98.

In the regression that is conditional on Pilotdrg=0, transfer patients grouped into the non-pilot DRGs stayed, on average, .50 of a day longer than those patients not transferred to post-acute care. Those patients discharged after 10/01/98 stayed an average of -.22 of a day less than those discharged before 10/01/98 and those transferred to post-acute care after 10/01/98 had LOS an average of .01 shorter than other patients.

One can see that the differences between the two regressions are relatively small. Only, the race variables have differences of at least half a day. The PostBBA variable shows a difference of only .16 between the two groups and the transfer variable shows a .36 difference. Lastly, the PostBBATransfer variable represents a .05 difference between the treatment and control groups.

Given these small differences, it would be a good idea to check to see if the coefficients are the same. That is, if there is any difference between the patients grouped into the non-pilot and pilot DRGs. The process used here is relatively simple. It involves first interacting the Pilotdrg dummy variable with all of the independent variables included in the previously run regression. Once these variables are generated, one regression is run which includes the non-interacted variables and the interacted variables. Results are in Table 3.23. Once the regression is performed, each of the interaction variable coefficients is tested to see if it equals zero. For each, the null and alternative hypotheses are as follows:

$$H_0: \beta_i = 0$$

$$H_A: \beta_i \neq 0$$

β_i is the coefficient on interaction variable i. If the null hypothesis cannot be rejected, then the possibility exists that, for variable i, there is not a measurable difference between the treatment group (the patients in the Pilotdrg category), and the control group (those in the Nonpilot category). Test results are also in Table 3.23.

Among the variables of interest, I cannot reject the null hypothesis for PostbbaPilot or PostbbapilotTransfer but can reject the null hypothesis for PilotDRGTransfer, implying that there may be some difference between patients grouped into pilot drgs and transferred and those patients that were not, but these differences might not have been affected by the changes in the Balanced Budget Act.

Section VI

This paper examines the implementation of the Post Acute Care transfer policy to determine the treatment effect on Medicare patients transferred to post acute care. My analysis, thus far, shows that, on average, the implementation of the Post Acute Care Transfer Policy as set forth in the Balanced Budget Act of 1997 did not result, on average, in significant increases in length of stay over all the "pilot" DRGs affected by this policy. Based on this alone, one might conclude that, if shorter lengths of stay did exist for these patients prior to the implementation of the Balanced Budget Act provision, they were possibly the result of more efficient hospital treatment of patients, rather than exploitation of a financial loophole, contradicting the suspicions of the Healthcare Financing Administration (now the Centers for Medicare and Medicaid Services).

In order to determine if the policy had effects on hospital behavior reaching beyond what was intended, the regressions started off generally and became more specific. All the regressions employed simple OLS. The first regressions were the most general, aiming to look at the effects of the policy on all discharges in the dataset, regardless of DRG or time frame. Additional regressions controlled for transfer status and the analysis continued, employing a semi-log model. To round out the analysis, the issue of timing was addressed, the aim being to possibly get at behavior changes that do not occur at the BBA's provision's effective date. The counterintuitive results in the early regressions are likely reflective of the fact that the equations were not specific enough given the intent of the bill. While the variables of interest in these regressions were significant by conventional standards, the regressions did not yield the expected results.

Clearly, the main thrust of this analysis is the examination of the "short stay" patients. All other analyses point to the idea that this policy only affected the intended population. These regressions yield the most interesting results. In analyzing the shortstay patients, as shown in Table 3.22, the data show that patients that were grouped into the pilot DRGs and were transferred were in the hospital, on average, nearly a day (.87) longer than those who were not transferred, however, being transferred after 10/01/98 did not appear to make a significant difference on length of stay. The final regression, in Table 3.23, performs tests to see whether there is any difference between the interacted variables and zero, with the results indicating that there may not be any significant difference between the treatment (the Pilot diagnosis related groups) and control groups (the Non-pilot diagnosis related groups). Therefore, it is possible, prior to the passage of the Balanced Budget Act, hospitals were not just exploiting a financial loophole, but may have been merely treating patients efficiently.

The Implications of these Results and Fitting Them into the Big Picture of the Balanced Budget Act of 1997

As outlined in the introduction, the Medicare provisions of the Balanced Budget Act of 1997 intended to modernize Medicare, expand benefits, and extend the life of the Medicare trust fund. It is important to examine this legislation because the provisions present financial incentives to the healthcare industry that can alter how patients are treated. The provision examined in this paper is based on the belief that healthcare providers were probably shifting care away from relatively more expensive inpatient settings to relatively less expensive post acute care settings. Therefore, in enacting this legislation, the government has put in place an incentive for hospitals not to transfer patients "too early", that is, transfer the patient to post acute at least 1 day less than the geometric mean length of stay. The results of this analysis suggest that the Medicare provision may not have had the intended effect on hospital behavior.

My results indicate an increase in length of stay for shortstay patients. However, the provision did not eliminate shortstay patients completely. It is possible that the trends seen in healthcare were a partial result of a natural evolution of the healthcare industry and not purely a result of financial incentives.

Given that these results show that patients are being kept longer, it could be that patients are being kept long enough so that hospitals can receive the full DRG payment. Therefore, it is possible that Medicare is not actually saving money but breaking even, when before they may have been subsidizing short stays. The hospitals are now, if they are in fact keeping patients longer, incurring more in charges, the question being whether or not the DRG payment actually matches the costs the hospitals incur. These patients are then transferred to post acute care, which is now (or will be) subject to prospective payment. Future research will need to probe what the effect of this system has been on patients and post acute care.

The previous two chapters discussed topics in health economics from distinct vantage points: the labor market, publicly provided health care and, to a lesser extent, industrial organization. The concluding chapter presents some final thoughts

Table 3.1

DRGs Examined for Post Acute Care Policy

DRGs Not Included in Policy ("Non-Pilot DRGs")		*DRGs Included in Policy ("Pilot Drgs")*	
DRG	Title	DRG	Title
1	Craniotomy, >17 Exc. Trauma	14	Specific Cerebrovascular Disorders Except Transient Ischemic Attack
79	Respiratory Infection and Inflammation >17 w/CC	113	Amputation for Circulatory System Disorders Excluding Upper Limb and Toe
106	Coronary Bypass w/PTCA	209	Major Joint Limb Reattachment Procedures of Lower Extremity
107	Coronary Bypass w/Cardiac Cath	210	Hip and Femur Procedures Except Major Joint Age>17 with CC
148	Major Bowel Procedure w/CC	211	Hip and Femur Procedures Except Major Joint Age>17 without CC
239	Path Fractures, Musculoskeletal Connective Tissue Malignancy	236	Fractures of Hip and Pelvis
243	Medical Back Problems	263	Skin Graft and/or Debridement for Skin Ulcer or Cellulitis with CC
296	Nutrition and Misc. Metabolic Disorders, >17 w/CC	264	Skin Graft and/or Debridement for Skin Ulcer or Cellulitis without CC
415	Operating Room Proc for Infect/Parasitic Disease	429	Organic Disturbances and Mental Retardation
468	Extensive Operating Room Procedure Unrelated to Principal Diagnosis	483	Tracheostomy Except for Face, Mouth and Neck Diagnosis

Note: DRGs 1, 106, 107, 113, ,148, 209, 210, 211, 263, 264, 415, and 483 are surgical DRGs while DRGs 14, 79, 236, 239, 243, 296, 429 and 468 are medical DRGs.

CC= Complications and comorbidities

Table 3.2
Summary Statistics (N=717,784)

Variable	Mean
Length of Stay	7.5423
Age	78.726
Female	0.6197
Non-Pilot DRGs	
DRG 1, Craniotomy, >17 Exc. Trauma	0.016
DRG 79, Respiratory Infection and Inflammation >17 w/CC	0.0823
DRG 106, Coronary Bypass w/PTCA	0.0074
DRG 107, Coronary Bypass w/Cardiac Cath	0.0438
DRG 148, Major Bowel Proc. w/CC	0.0694
DRG 239, Path Fractures, Musculoskeletal Connective Tissue Malignancy	0.0295
DRG 243, Medical Back Problems	0.0443
DRG 296, Nutrition and Misc. Metabolic Disorders, >17 w/CC	0.1139
DRG 415, Operating Room Procedure for Infect/Parasitic Disease	0.0166
DRG 468, Extensive Operating Room Procedure Unrelated to Principal Diagnosis	0.0254
Pilot DRGs	
DRG 14, Specific Cerebrovascular Disorders Except Transient Ischemic Attack	0.1702
DRG 113, Amputation for Circulatory System Disorders Excluding Upper Limb and Toe	0.0188
DRG 209, Major Joint Limb Reattachment Procedures of Lower Extremity	0.1927
DRG 210, Hip and Femur Procedures Except Major Joint Age>17 with CC	0.0711
DRG 211, Hip and Femur Procedures Except Major Joint Age>17 without CC	0.0172
DRG 236, Fractures of Hip and Pelvis	0.0284
DRG 263, Skin Graft and/or Debridement for Skin Ulcer or Cellulitis with CC	0.0102
DRG 264, Skin Graft and/or Debridement for Skin Ulcer or Cellulitis without CC	0.0016
DRG 429, Organic Disturbances and Mental Retardation	0.0276
DRG 483, Tracheostomy Except for Face, Mouth and Neck Diagnosis	0.0136
Race	
White	0.8578
Black	0.0705
Hispanic	0.0436
Asian	0.0131
Native American	0.0013
Other Race	0.0136
Hospital Size	
Small	0.1304
Medium	0.2686
Large	0.601
Hospital Region	
Northeast	0.1839
Midwest	0.1837
South	0.4256
West	0.2069
Hospital Control	
Government/Private Collapsed	0.4946
Government, nonfederal	0.0784
Private, nonprofit	0.2389
Private, investor owned	0.1341
Private, collapsed	0.054
Dummy Variables	
Post BBA	0.8627
PilotDRG	0.5514
Transfer	0.6937

Note: Some of the variables here are further defined and described
in Tables III and IV.

Table 3.3

Independent Variables Utilized In Regression Analyses

Variables	Variable Label(s) Used in Dataset
Individual Characteristics	
AGE (in years)	AGE
Female (=1 if female)	FEMALE
Race (=1 if race i)	WHITE
	BLACK
	HISPANIC
	ASIAN
	NATAMER
	OTHRACE
Hospital Characteristics	
Hospital Bed Size	SMHOSP
Note: Further definitions of the hospital bed size variables are contained in Table IV.	MEDHOSP
	LGHOSP
Location/Teaching Status of Hospital	RURAL
	URBNOTEACH
	URBTEACH
Hospital Region (based on census regions)	NE
	MIDWEST
	SOUTH
	WEST
Hospital Control	GOVTPRIV
	GOVNONFED
	PRIVNONPR
	PRIVPROF
	PRIVOTHER
BBA-Associated Variables, Including Interaction Variables	
PostBBA (=1 if the discharge took place after10/01/98)	POSTBBA
PilotDRG (=1 if the patient grouped into "pilot" DRG)	PILOTDRG
PostBBAPILOT (=1 if the discharge took place after10/01/98 and patient is grouped into a "pilot" DRG)	POSTBBAPILOT
PostBBADRG$_i$ (=1 if the discharge took place after 10/01/98 and the patient is grouped into DRG$_i$)	POSTBBADRG$_i$
Transfer (=1 if the patient was transferred to post acute care	TRANSFER
PostBBATransfer (=1 if the patient was transferred to post acute care after 10/01/98)	POSTBBATRANSFER
PostBBAPilotTransfer (=1 if the patient was transferred to post acute care after 10/01/98 and grouped into a "pilot" DRG.	POSTBBAPILOTTRANSFER
PostBBADRGiTransfer (=1 if the transfer took place after 10/01/98 and the patient is grouped into DRGi)	POSTBBADRGiTransfer

Table 3.4
Bed Size Categories, By Region
(Source: HCUP)

Location and Teaching Status	Hospital Bed Size		
	Small	Medium	Large
	Northeast		
Rural	<49	50-99	100+
Urban, Non-Teaching	<124	125-199	200+
Urban, Teaching	<249	250-424	425+
	Midwest		
Rural	<29	30-49	50+
Urban, Non-Teaching	<74	75-174	175+
Urban, Teaching	<249	250-374	375+
	South		
Rural	<39	40-74	75+
Urban, Non-Teaching	<99	100-199	200+
Urban, Teaching	<249	250-449	450+
	West		
Rural	<24	25-44	45+
Urban, Non-Teaching	<99	100-174	175+
Urban, Teaching	<199	200-324	325+

Table 3.5
Regression Results, Equation 1
Dependent Variable: Length of Stay
Constant=9.63093

Variable	Coefficient	Standard Error	t-value
Age	-0.002609	0.0012453	-2.09
Female	-0.605022	0.0198729	-30.44
Black	1.619981	0.0377558	42.91
Hispanic	0.9724109	0.047244	20.58
Asian	1.900013	0.0852679	22.28
Native American	0.9239064	0.2602649	3.55
Other Race	0.7249161	0.0822647	8.81
Small Hospital	-0.454286	0.0322668	-14.08
Large Hospital	0.6356079	0.0223306	28.46
Rural	-0.769309	0.0340724	-22.58
Urban Teaching	0.7576919	0.0339298	22.33
Midwest	-1.759315	0.0339092	-51.88
South	-1.607219	0.0362892	-44.29
West	-1.807021	0.0395302	-45.71
Gov't or Private	-0.166711	0.0469979	-3.55
Gov't Nonfederal	-0.21053	0.0443726	-4.74
Private Nonprofit	-0.130295	0.0329554	-3.95
Private Other	-0.29352	0.063085	-4.65
PostBBA	0.0605915	0.0417786	1.45
PilotDRG	-1.509794	0.0515573	-29.28
PostBBAPilot	0.3017544	0.0554799	5.44

N=717784
F=897.79
R^2=.0256

Table 3.6
Regression Results, Equation 2
Dependent Variable: Length of Stay
Constant:4.670573

Variable	Coefficient	Std.Error	t-Value
Age	0.0274058	0.0011015	24.88
Female	0.0274427	0.0171368	1.6
Black	1.008862	0.0324071	31.13
Asian	1.382297	0.0724577	19.08
Hispanic	0.6435091	0.0401654	16.02
Native American	0.9576045	0.2208734	4.34
Other Race	0.3949922	0.069832	5.66
Small Hospital	-0.2380487	0.0274013	-8.69
Large Hospital	0.3900299	0.0189963	20.53
Rural	-0.3398719	0.0290145	-11.71
Urban Teaching	0.3508052	0.0288443	12.16
Midwest	-1.455391	0.0288182	-50.5
South	-1.397508	0.0308196	-45.34
West	-1.478717	0.0335907	-44.02
Gov't, private collapsed	0.0233699	0.0398976	0.59
Gov't, nonfederal	-0.0560313	0.03768	-1.49
Private, Nonprofit	-0.0155078	0.027988	-0.55
Private, Other	-0.1805167	0.0535645	-3.37
PostBBA	0.2037237	0.0540489	3.77
Pilot DRGs			
DRG113	3.912666	0.1778814	22
DRG209	-1.019596	0.0706586	-14.43
DRG210	-0.0616486	0.0955222	-0.65
DRG211	-1.578132	0.192224	-8.21
DRG236	1.655157	0.1325738	12.48
DRG263	2.892087	0.2127469	13.59
DRG264	-0.2543868	0.5880265	-0.43
DRG429	2.644486	0.1538178	17.19
DRG483	25.59634	0.1921556	133.21
Non-Pilot DRGs			
DRG79	2.788888	0.0876534	31.82
DRG106	4.091661	0.116063	35.25
DRG107	1.923218	0.1445416	13.31
DRG148	5.266046	0.0962156	54.73
DRG239	0.266293	0.1368622	1.95
DRG243	-0.9587485	0.1191991	-8.04
DRG296	-1.169694	0.0854375	-13.69
DRG415	6.335922	0.1717608	36.89
DRG468	5.865768	0.1546063	37.94
Pilot DRGs			
PostBBADRG113	0.9081011	0.1895932	4.79
PostBBADRG209	-0.1786538	0.0760133	-2.35
PostBBADRG210	0.2787561	0.1027703	2.71
PostBBADRG211	0.0424596	0.2039435	0.21
PosBBADRG236	-1.202728	0.1436888	-8.37
PostBBADRG263	1.857765	0.2306072	8.06
PostBBADRG264	0.4887206	0.626852	0.78
PostBBADRG429	0.0910564	0.16345	0.56
PostBBADRG483	7.609885	0.2070036	36.76
Non-Pilot DRGs			
PostBBADRG79	-0.288339	0.0949212	-3.04
PostBBADRG106	1.042929	0.2438357	4.28
POstBBADRG107	2.074568	0.1511231	13.73
PostBBADRG148	0.063955	0.1036566	0.62
PostBBADRG239	-0.3207216	0.1472451	-2.18
PostBBADRG243	-0.3065246	0.1276163	-2.4
PostBBADRG296	0.1273197	0.0913702	1.39
PostBBADRG415	0.9006424	0.1856704	4.85
PostBBADRG468	0.200403	0.1649611	1.21

N=717784
F=5549.81
R^2=.2984

Table 3.7
Regression Results, Equation 3
Dependent Variable: Length of Stay
Constant: 9.571806

Variable	Coefficient	Std.Error	t-Value
Age	-0.0286828	0.0012566	-22.83
Female	-0.696178	0.0197299	-35.29
Black	1.598881	0.0374394	42.71
Asian	1.982839	0.0845421	23.45
Hispanic	1.075905	0.046849	22.97
Native American	1.040552	0.2580473	4.03
Other Race	0.7045837	0.0815627	8.64
Small Hospital	-0.4386129	0.0319919	-13.71
Large Hospital	0.6458664	0.0221407	29.17
Rural	-0.6681979	0.0337952	25.11
Urban Teaching	0.844925	0.0336502	25.11
Midwest	-1.654639	0.0336316	-49.2
South	-1.443199	0.0360107	-40.08
West	-1.692578	0.0392072	-43.17
Gov't, private collapsed	-0.0425233	0.0466107	-0.91
Gov't, nonfederal	-0.1008894	0.0440058	-2.29
Private, Nonprofit	0.0126322	0.0326999	0.39
Private, Other	-0.1860314	0.0625542	-2.97
Transfer	2.625022	0.0259134	101.3
PostBBA	0.5005109	0.0326395	15.33
PilotDRG	-1.381747	0.0294256	-46.96
PostBBAPilotTransfer	-0.6337176	0.0367294	-17.25

N=717784
F=1435.60
R^2=.0421

Table 3.8
Regression Results, Equation 4
Dependent Variable: Length of Stay
Constant: 4.6382

Variable	Coefficient	Std.Error	t-Value
Age	0.0056478	0.0011084	5.1
Female	-0.0510835	0.0169772	-3.01
Black	0.947559	0.0320615	29.55
Asian	1.453919	0.0716691	20.29
Hispanic	0.7132778	0.0397324	17.95
Native American	0.9905633	0.2184727	4.53
Othrace	0.3558759	0.0690651	5.15
Small Hospital	-0.2277191	0.0271033	-8.4
Large Hospital	0.4076875	0.0187891	21.7
Rural	-0.263672	0.0287082	-9.18
Urban Teaching	0.4446047	0.0285387	15.58
Midwest	-1.372438	0.0285274	-48.11
South	-1.24469	0.030515	-40.79
West	-1.370544	0.0332402	-41.23
Gov't, private collapsed	0.1174144	0.0394751	2.97
Gov't, nonfederal	0.0254534	0.0372751	0.68
Private, Nonprofit	0.1042331	0.0277042	3.76
Private, Other	-0.0998334	0.0529882	-1.88
PostBBA	0.4976645	0.0314631	15.82
Transfer	1.893239	0.0303774	62.32
Pilot DRG's			
DRG113	4.694134	0.1236498	37.96
DRG209	-0.5892604	0.0423285	-13.92
DRG210	0.4251968	0.0713948	5.96
DRG211	-1.041212	0.1316436	-7.91
DRG236	1.904685	0.0931235	20.45
DRG263	3.790782	0.1352686	28.02
DRG264	0.6949265	0.2919624	2.38
DRG429	3.393345	0.0809169	41.94
DRG483	27.54741	0.1489541	184.94
Non-Pilot DRG's			
DRG79	2.802233	0.0519341	53.96
DRG106	4.561893	0.1033341	44.15
DRG107	3.59825	0.0581257	61.9
DRG148	4.692819	0.0474004	99
DRG239	0.4037091	0.0759466	5.32
DRG243	-0.7588262	0.0580798	-13.07
DRG296	-0.7573248	0.0416193	-18.2
DRG415	5.789864	0.0996072	58.13
DRG468	4.275523	0.0754302	56.68
Pilot DRG's			
PostBBADRG113Transfer	-0.4681994	0.1408478	-3.32
PostBBADRG209Transfer	-1.252154	0.0493642	-25.37
PostBBADRG210Transfer	-0.7490645	0.0796281	-9.41
PostBBADRG211Transfer	-1.013866	0.1491961	-6.8
PostBBADRG236Transfer	-2.030391	0.1092773	-18.58
PostBBADRG263Transfer	0.8803581	0.1679575	5.24
PostBBADRG264Transfer	-0.7055762	0.4029418	-1.75
PostBBADRG429Transfer	-0.9886789	0.102818	-9.62
PostBBADRG483Transfer	5.235777	0.1681443	31.14
Non-Pilot DRG's			
PostBBADRG79Transfer	-0.4773	0.0644889	-7.4
PostBBADRG106Transfer	1.233088	0.3179762	3.88
PostBBADRG107Transfer	0.967768	0.0825167	11.73
PostBBADRG148Transfer	2.416556	0.0689371	35.05
PostBBADRG239Transfer	-0.6045363	0.0985856	-6.13
PostBBADRG243Transfer	-0.3427165	0.0818985	-4.18
PostBBADRG296Transfer	0.0799059	0.0564352	1.42
PostBBADRG415Transfer	2.156454	0.1291585	16.7
PostBBADRG468Transfer	3.894762	0.1045448	37.25

N=717784
F=5854.47
R^2=.3136

Table 3.9
Regression Results, Equation 1
Conditional on Transfer=1
Dependent Variable: Length of Stay
Constant: 13.91939

Variable	Coefficient	Standard Error	t-value
Age	-0.0446298	0.0016168	-27.6
Female	-0.9331988	0.0261171	-35.73
Black	1.676303	0.0494526	33.9
Hispanic	1.214172	0.0636001	19.09
Asian	2.424588	0.1142992	21.21
Native American	1.36872	0.359561	3.81
Other Race	0.6553724	0.105789	6.2
Small Hospital	-0.53957	0.0415079	-13
Large Hospital	0.7432093	0.0288129	25.79
Rural	-0.8624509	0.044675	-19.31
Urban Teaching	0.8981306	0.0431426	20.82
Midwest	-1.630277	0.043403	-37.56
South	-1.460997	0.0472484	-30.92
West	-1.662932	0.0511087	-32.54
Gov't Private	-0.0092453	0.0600612	-0.15
Gov't Nonfederal	-0.1909527	0.0570484	-3.35
Private Nonprofit	-0.0287663	0.042022	-0.68
Private Other	-0.1569847	0.0818719	-1.92
PostBBA	0.231552	0.0596205	3.88
PilotDRG	-2.278573	0.0688984	-33.07
PostBBAPilot	0.1886523	0.0741294	2.54

Note: N=497947
F=922.10
R^2=.0374

Table 3.10
Regression Results, Equation 2
Conditional on Transfer=1
Dependent Variable: Length of Stay
Constant: 7.788709

Variable	Coefficient	Std.Error	t-Value
Age	-0.0070023	0.0014116	-4.96
Female	-0.190142	0.0221927	-8.57
Black	0.7474812	0.0418891	17.84
Asian	1.65258	0.0957511	17.26
Hispanic	0.6652514	0.0533023	12.48
Native American	1.12837	0.3007609	3.75
Othrace	0.2881761	0.0885139	3.26
Small Hospital	-0.2921802	0.0347408	-8.41
Large Hospital	0.4933987	0.0241501	20.43
Rural	-0.4004358	0.0374849	-10.68
Urban Teaching	0.4668921	0.0361366	12.92
Midwest	-1.336231	0.0363457	-36.76
South	-1.208308	0.0395527	-30.55
West	-1.315758	0.0428185	-30.73
Gov't, private collapsed	0.2148014	0.050252	4.27
Gov't, nonfederal	0.035483	0.0477501	0.74
Private, Nonprofit	0.1412994	0.0351758	4.02
Private, Other	-0.0256455	0.0685168	-0.37
PostBBA	0.3392433	0.0693851	4.89
Pilot DRGs			
DRG113	3.338942	0.2063412	16.18
DRG209	-1.675217	0.0869936	-19.26
DRG210	-0.5342174	0.1007303	-4.82
DRG211	-2.048011	0.2218451	-9.23
DRG236	0.9955728	0.1570029	6.34
DRG263	2.42335	0.2616549	9.26
DRG264	-0.4821428	0.7764619	-0.62
DRG429	2.480821	0.2032955	12.2
DRG483	24.98695	0.2159863	115.69
Non-Pilot DRGs			
DRG79	2.67785	0.1110909	24.11
DRG106	4.379412	0.1695066	25.84
DRG107	1.852129	0.2139495	8.66
DRG148	6.695817	0.142232	47.08
DRG239	-0.0832764	0.1749304	-0.48
DRG243	-0.8173748	0.1697635	-4.81
DRG296	-0.8594929	0.1212308	-7.09
DRG415	6.90365	0.2253206	30.64
DRG468	7.575617	0.2159676	35.08
Pilot DRGs			
PostBBADRG113	0.7627947	0.2197285	3.47
PostBBADRG209	-0.3091462	0.0935312	-3.31
PostBBADRG210	0.1544608	0.1191289	1.3
PostBBADRG211	-0.0755374	0.2352806	-0.32
PosBBADRG236	-1.165053	0.1699075	-6.86
PostBBADRG263	2.170862	0.2833904	7.66
PostBBADRG264	0.3940168	0.8320058	0.47
PostBBADRG429	-0.1565688	0.2153634	-0.73
PostBBADRG483	7.591349	0.2327098	32.62
Non-Pilot DRGs			
PostBBADRG79	-0.440605	0.1201286	-3.67
PostBBADRG106	1.156171	0.3650431	3.17
PostBBADRG107	2.45435	0.2237604	10.97
PostBBADRG148	0.2929886	0.1532636	1.91
PostBBADRG239	-0.1987291	0.1885784	-1.05
PostBBADRG243	-0.3569031	0.181778	-1.96
PostBBADRG296	0.124247	0.1294246	0.96
PostBBADRG415	0.8822364	0.2427892	3.63
PostBBADRG468	0.4634483	0.2303792	2.01

Note: N=497947
F=4391.32
R^2=.3266

Table 3.11
Regression Results, Equation 5
Dependent Variable: Log Length of Stay
Constant: 1.755033

Variable	Coefficient	Standard Error	t-value
Age	0.0023925	0.0001101	21.73
Female	-0.0554111	0.0017566	-31.54
Black	0.1355975	0.0033374	40.63
Hispanic	0.1003714	0.0041761	24.03
Asian	0.1592454	0.0075371	21.13
Native American	0.0529566	0.0230056	2.3
Other Race	0.0814954	0.0072716	11.21
Small Hospital	-0.0562017	0.0028522	-19.7
Large Hospital	0.0627062	0.0019739	31.77
Rural	-0.0690899	0.0030118	-22.94
Urban Teaching	0.0598092	0.0029992	19.94
Midwest	-0.1452125	0.0029973	-48.45
South	-0.1285352	0.0032077	-40.07
West	-0.1946779	0.0034942	-55.71
Gov't Private	-0.0040401	0.0041543	-0.97
Gov't Nonfederal	-0.0301669	0.0039222	-7.69
Private Nonprofit	-0.0058127	0.002913	-2
Private Other	-0.0356488	0.0055763	-6.39
PostBBA	-0.0137706	0.0036929	-3.73
PilotDRG	-0.21776	0.0045573	-47.78
PostBBAPilot	0.0481504	0.004904	9.82

Note: N=717784
F=1309.42
R^2=.0369

Table 3.12

Interpretations of Dummy Variable Coefficients: Halvorsen and Palmquist (1980)

Variable	Coefficient	The % Change in the Dependent Variable Per Change in the Dummy Variable
Female	-0.0554111	-5.39%
Black	0.1355975	14.52%
Hispanic	0.1003714	10.55%
Asian	0.1592454	17.26%
Native American	0.0529566	5.43%
Other Race	0.0814954	8.49%
Small Hospital	-0.0562017	-5.62%
Large Hospital	0.0627062	6.47%
Rural	-0.0690899	-6.67%
Urban Teaching	0.0598092	6.10%
Midwest	-0.1452125	-13.51%
South	-0.1285352	-12.06%
West	-0.1946779	-17.69%
Gov't Private	-0.0040401	0.40%
Gov't Nonfederal	-0.0301669	-2.90%
Private Nonprofit	-0.0058127	-0.58%
Private Other	-0.0356488	-3.50%
PostBBA	-0.0137706	-1.36%
PilotDRG	-0.21776	-19.57%
PostBBAPilot	0.0481504	4.93%

Table 3.13
Regression Results, Equation 6
Dependent Variable: Length of Stay
Constant: 9.614609

Variable	Coefficient	Standard Error	t-value
Age	-0.0025787	0.0012453	-2.07
Female	-0.6054552	0.0198721	-30.47
Black	1.612596	0.0377734	42.69
Hispanic	0.9780725	0.0472548	20.7
Asian	1.896992	0.0852656	22.25
Native American	0.919577	0.2602579	3.53
Other Race	0.7220149	0.0822628	8.78
Small Hospital	-0.4526784	0.0322667	-14.03
Large Hospital	0.6363455	0.0223301	28.5
Rural	-0.7750284	0.0340845	-22.74
Urban Teaching	0.7606627	0.0339311	22.42
Midwest	-1.757739	0.0339099	-51.84
South	-1.595462	0.0363412	-43.9
West	-1.784741	0.0396941	-44.96
Gov't Private	-0.1811208	0.0470494	-3.85
Gov't Nonfederal	-0.2144744	0.0443751	-4.83
Private Nonprofit	-0.1381547	0.0329805	-4.19
Private Other	-0.3001889	0.0630902	-4.76
LagPostBBA	0.080306	0.0378553	2.12
PilotDRG	-1.516681	0.0449758	-33.72
LagPostBBAPilot	0.3271115	0.0496496	6.59

N=717784
F=897.79
R^2=.0256

Table 3.14
Regression Results, Equation 7
Dependent Variable: Length of Stay
Constant: 4.640194

Variable	Coefficient	Std.Error	t-Value
Age	0.0275085	0.0011011	24.98
Female	0.0278989	0.0171304	1.63
Black	0.9980213	0.0324119	30.79
Asian	1.383373	0.0724337	19.1
Hispanic	0.6546233	0.0401662	16.3
Native American	0.9509022	0.2207926	4.31
Othrace	0.383486	0.0698035	5.49
Small Hospital	-0.2371612	0.0273924	-8.66
Large Hospital	0.3889129	0.0189891	20.48
Rural	-0.3445757	0.0290152	-11.88
Urban Teaching	0.3494827	0.0288375	12.12
Midwest	-1.448816	0.0288105	-50.29
South	-1.378299	0.0308551	-44.67
West	-1.448972	0.0337197	-42.97
Gov't, private collapsed	0.0102889	0.0399288	0.26
Gov't, nonfederal	-0.0650537	0.037668	-1.73
Private, Nonprofit	-0.0286734	0.0280008	-1.02
Private, Other	-0.1883194	0.0535504	-3.52
LagPostBBA	0.2385402	0.0483575	4.93
Pilot DRGs			
DRG113	3.940521	0.1562081	25.23
DRG209	-0.9875618	0.0612641	-16.12
DRG210	-0.0580834	0.0823265	-0.71
DRG211	-1.571264	0.1643744	-9.56
DRG236	1.630359	0.114224	14.27
DRG263	3.247462	0.1856075	17.5
DRG264	-0.3035004	0.5166668	-0.59
DRG429	2.588013	0.1335498	19.38
DRG483	25.6255	0.1686673	151.93
Non-Pilot DRGs			
DRG79	2.781333	0.0766846	36.27
DRG106	4.098889	0.1127259	36.36
DRG107	2.685633	0.117349	22.89
DRG148	5.22286	0.0834719	62.57
DRG239	0.1892371	0.119436	1.58
DRG243	-0.9571425	0.1033943	-9.26
DRG296	-1.145634	0.0743624	-15.41
DRG415	6.405126	0.1493821	42.88
DRG468	5.755037	0.1339857	42.95
Pilot DRGs			
LagPostBBADRG113	0.9111351	0.1699627	5.36
LagPostBBADRG209	-0.2271363	0.0676985	-3.36
LagPostBBADRG210	0.2916912	0.0911143	3.2
LagPostBBADRG211	0.0335158	0.1785629	0.19
LagPostBBADRG236	-1.252198	0.1277598	-9.8
LagPostBBADRG263	1.524669	0.2069439	7.37
LagPostBBADRG264	0.5655171	0.562189	1.01
LagPostBBADRG429	0.160499	0.1449974	1.11
LagPostBBADRG483	7.953302	0.1862003	42.71
Non-Pilot DRGs			
LagPostBBADRG79	-0.296264	0.0853312	-3.47
LagPostBBADRG106	1.111997	0.2477348	4.49
LagPostBBADRG107	1.307672	0.1258077	10.39
LagPostBBADRG148	0.1218906	0.0923968	1.32
LagPostBBADRG239	-0.243335	0.1317833	-1.85
LagPostBBADRG243	-0.3249961	0.1134575	-2.86
LagPostBBADRG296	0.1020962	0.0814252	1.25
LagPostBBADRG415	0.8685464	0.1660411	5.23
LagPostBBADRG468	0.3407232	0.1463508	2.33

N=717784
F=5563.80
R2=.2989

Table 3.15
Regression Results, Equation 8
Dependent Variable: Length of Stay
Constant: 9.61448

Variable	Coefficient	Std.Error	t-Value
Age	-0.028566	0.0012566	-22.73
Female	-0.6987361	0.0197294	-35.42
Black	1.592805	0.0374588	42.52
Asian	1.980467	0.0845453	23.42
Hispanic	1.08464	0.0468631	23.14
Native American	1.980467	0.0845453	23.42
Othrace	0.7020634	0.0815661	8.61
Small Hospital	-0.4360464	0.0319938	-13.63
Large Hospital	0.6461167	0.0221415	29.18
Rural	-0.674657	0.0338092	-19.95
Urban Teaching	0.8472488	0.0336537	25.18
Midwest	-1.652254	0.0336344	-49.12
South	-1.430724	0.0360651	-39.67
West	-1.668406	0.0393731	-42.37
Gov't, private collapsed	-0.057341	0.0466658	-1.23
Gov't, nonfederal	-0.1041822	0.0440123	-2.37
Private, Nonprofit	0.0037866	0.0327265	0.12
Private, Other	-0.1918539	0.0625635	-3.07
Transfer	2.571912	0.0253326	101.53
PilotDRG	-1.46377	0.0282046	-51.9
LagPostBBA	0.5003743	0.0302868	16.52
LagPostBBAPilotTransfer	-0.5219241	0.03576	-14.6

N=717784
F=1433.80
R^2=.0421

Table 3.16
Regression Results, Equation 9
Dependent Variable: Length of Stay
Constant: 4.689926

Variable	Coefficient	Std.Error	t-Value
Age	0.0057916	0.0011082	5.23
Female	-0.0517231	0.0169742	-3.05
Black	0.9378227	0.0320721	29.24
Asian	1.45239	0.0716599	20.27
Hispanic	0.7286519	0.0397405	18.34
Native American	0.983359	0.2184422	5.09
Othrace	0.3513093	0.0690561	5.09
Small Hospital	-0.2256348	0.0271004	-8.33
Large Hospital	0.4065664	0.0187866	21.64
Rural	-0.2694056	0.0287148	-9.38
Urban Teaching	0.443741	0.028537	15.55
Midwest	-1.364612	0.0285219	-47.84
South	-1.224249	0.030557	-40.06
West	-1.339346	0.0333746	-40.13
Gov't, private collapsed	0.1029228	0.0395169	2.6
Gov't, nonfederal	0.0182419	0.0372752	0.49
Private, Nonprofit	0.0908605	0.0277226	3.28
Private, Other	-0.1059475	0.052987	-2
LagPostBBA	0.4679063	0.0291071	16.08
Transfer	1.864351	0.0288034	64.73
Pilot DRGs			
DRG 113	4.51021	0.1159946	38.88
DRG 209	-0.6982915	0.0400169	-17.45
DRG 210	0.2394052	0.0649701	3.68
DRG 211	-1.183822	0.1222942	-9.68
DRG 236	1.764267	0.0865483	20.38
DRG 263	3.800832	0.1285216	29.57
DRG 264	0.6611635	0.2866109	2.31
DRG 429	3.303585	0.0783737	42.15
DRG 483	27.30591	0.1375955	198.45
Non-Pilot DRGs			
DRG 79	2.766233	0.0497238	55.63
DRG106	4.503837	0.1022837	44.03
DRG 107	3.61644	0.0566431	63.85
DRG 148	4.744954	0.0462196	102.66
DRG 239	0.3422787	0.0733031	4.67
DRG 243	-0.7819488	0.0566013	-13.82
DRG 296	-0.7798461	0.0404699	-19.27
DRG 415	5.90288	0.095746	61.65
DRG 468	4.370348	0.0735041	59.46
Pilot DRGs			
LagPostBBADRG113Tran	-0.2350692	0.1347507	-1.74
LagPostBBADRG209Tran	-1.152942	0.047334	-24.36
LagPostBBADRG210Tran	-0.5364348	0.0741898	-7.23
LagPostBBADRG211Tran	-0.8651171	0.1417	-6.11
LagPostBBADRG236Tran	-1.951327	0.1045986	-18.66
LagPostBBADRG263Tran	0.9231168	0.1643249	5.62
LagPostBBADRG264Tran	-0.6734182	0.4023649	-1.67
LagPostBBADRG429Tran	-0.8774208	0.1014522	-8.65
LagPostBBADRG483Tran	5.832019	0.1590267	36.67
Non-Pilot DRGs			
LagPostBBADRG79Tran	-0.4442843	0.0630311	-7.05
LagPostBBADRG106Tran	1.4058	0.3248249	4.33
LagPostBBADRG107Tran	0.9735616	0.0824187	11.81
LagPostBBADRG148Tran	2.403198	0.0688483	34.91
LagPostBBADRG239Tran	-0.5259725	0.0974279	-5.4
LagPostBBADRG243Tran	-0.3204367	0.0816523	-3.92
LagPostBBADRG296Tran	0.1181538	0.0558031	2.12
LagPostBBADRG415Tran	2.083898	0.1276101	16.33
LagPostBBADRG468Tran	3.878949	0.1041914	37.23

N=717784
F=5859.92
R^2 =.3138

Table 3.17
Regression Results, Equation 10
Dependent Variable: Length of Stay
Constant: 9.73182

Variable	Coefficient	Standard Error	t-value
Age	-0.0026247	0.0012453	-2.11
Female	-0.6042289	0.0198734	-30.4
Black	1.626958	0.0377462	43.1
Hispanic	0.9650583	0.0472322	20.43
Asian	1.902775	0.0852695	22.31
Native American	0.9270419	0.260273	3.56
Other Race	0.7269395	0.0822666	8.84
Small Hospital	-0.4566191	0.0322662	-14.15
Large Hospital	0.634724	0.022331	28.42
Rural	-0.7630442	0.0340644	-22.4
Urban Teaching	0.7545686	0.0339279	22.24
Midwest	-1.761821	0.0339079	-51.96
South	-1.619924	0.0362499	-44.69
West	-1.83127	0.0393851	-46.5
Gov't Private	-0.1521105	0.0469598	-3.24
Gov't Nonfederal	-0.2063697	0.0443706	-4.65
Private Nonprofit	-0.122085	0.0329381	-3.71
Private Other	-0.2869482	0.0630802	-4.55
AnticipateBBA	-0.0512633	0.0484993	-1.06
PilotDRG	-1.57185	0.0617432	-25.46
AnticipateBBAPilot	0.3568695	0.0649051	5.5

N=717784
F=895.72
R^2=.0255

Table 3.18
Regression Results, Equation 11
Dependent Variable: Length of Stay
Constant:4.501991

Variable	Coefficient	Std.Error	t-Value
Age	0.0273469	0.0011022	24.81
Female	0.0280523	0.0171466	1.64
Black	1.019012	0.0324162	31.44
Asian	1.383815	0.0724952	19.09
Hispanic	0.6308688	0.0401738	15.7
Native American	0.9420835	0.2209991	4.26
Othrace	0.3952344	0.0698701	5.66
Small Hospital	-0.2399825	0.0274155	-8.75
Large Hospital	0.3906578	0.0190063	20.55
Rural	-0.3339005	0.0290236	-11.5
Urban Teaching	0.3534936	0.0288566	12.25
Midwest	-1.462777	0.0288316	-50.74
South	-1.420672	0.0308019	-46.12
West	-1.514396	0.0334877	-45.22
Gov't, private collapsed	0.032989	0.0398852	0.83
Gov't, nonfederal	-0.0536863	0.0376965	-1.42
Private, Nonprofit	-0.0050953	0.0279884	-0.18
Private, Other	-0.177126	0.0535888	-3.31
Pilot DRGs			
DRG113	4.178221	0.2145716	19.47
DRG209	-1.050751	0.0846193	-12.42
DRG210	-0.0475344	0.115202	-0.41
DRG211	-1.552286	0.2325049	-6.68
DRG236	1.642492	0.1597568	10.28
DRG263	2.516048	0.256258	9.82
DRG264	-0.2510643	0.7396343	-0.34
DRG429	2.445903	0.1842981	13.27
DRG483	25.96434	0.2290754	113.34
Non-Pilot DRGs			
DRG79	2.765118	0.1031145	26.82
DRG106	4.163938	0.1381512	30.14
DRG107	1.849106	0.1721306	10.74
DRG148	5.300348	0.1155932	45.85
DRG239	0.4523446	0.1641553	2.76
DRG243	-1.006137	0.1433131	-7.02
DRG296	-1.148463	0.1038141	-11.06
DRG415	6.354393	0.2074869	30.63
DRG468	5.962151	0.184975	32.23
AnticipateBBA	0.1472438	0.0631388	2.33
Pilot DRGs			
AnticipateBBADRG113	0.5821544	0.2239905	2.6
AnticipateBBADRG209	-0.1365893	0.0889324	-1.54
AnticipateBBADRG210	0.249261	0.1209996	2.06
AnticipateBBADRG211	0.0156591	0.2419232	0.06
AnticipateBBADRG236	-1.124167	0.1686177	-6.67
AnticipateBBADRG263	2.178837	0.2705235	8.05
AnticipateBBADRG264	0.4605466	0.769431	0.6
AnticipateBBADRG429	0.3025502	0.1921173	1.57
AnticipateBBADRG483	6.856398	0.2411198	28.44
Non-Pilot DRGs			
AnticipateBBADRG79	-0.2476787	0.1090892	-2.27
AnticipateBBADRG106	0.1650902	0.2000136	0.83
AnticipateBBADRG107	2.105493	0.1775221	11.86
AnticipateBBADRG148	0.0213978	0.1215738	0.18
AnticipateBBADRG239	-0.5129337	0.17252	-2.97
AnticipateBBADRG243	-0.2410397	0.1500922	-1.61
AnticipateBBADRG296	0.0994189	0.1085405	0.92
AnticipateBBADRG415	0.8324467	0.2185771	3.81
AnticipateBBADRG468	0.0877136	0.1933781	0.45

N=717784
F=5528.60
R2=.2976

Table 3.19
Regression Results, Equation 12
Dependent Variable: Length of Stay
Constant: 9.55283

Variable	Coefficient	Std.Error	t-Value
Age	-0.0287726	0.0012565	-22.9
Female	-0.6931173	0.0197301	-35.13
Black	1.604052	0.0374278	42.86
Asian	1.984536	0.0845378	23.48
Hispanic	1.066696	0.0468336	22.78
Native American	1.043087	0.2580377	4.04
Othrace	0.7068489	0.0815588	8.67
Small Hospital	-0.4407686	0.0319892	-13.78
Large Hospital	0.6456676	0.0221396	29.16
Rural	-0.6618132	0.033785	-19.59
Urban Teaching	0.8423295	0.033646	25.04
Midwest	-1.657532	0.033628	-49.29
South	-1.455431	0.0359689	-40.46
West	-1.716837	0.03906	-43.95
Gov't, private collapsed	-0.0289913	0.0465689	-0.62
Gov't, nonfederal	-0.0985595	0.0439998	-2.24
Private, Nonprofit	0.0204726	0.0326805	0.63
Private, Other	-0.1808736	0.0625449	-2.89
Transfer	2.687512	0.0265892	101.08
AnticipateBBA	0.4668635	0.0367398	12.71
PilotDRG	-1.285244	0.0308221	-41.7
AnticipateBBAPilotTransfer	-0.757911	0.0379717	-19.96

N=717784
F=1438.26
R^2=.0422

Table 3.20
Regression Results, Equation 13
Dependent Variable: Length of Stay
Constant: 4.588654

Variable	Coefficient	Std.Error	t-Value
Age	0.0054819	0.0011087	4.94
Female	-0.0501721	0.0169822	-2.95
Black	0.9577767	0.032061	29.87
Asian	1.456301	0.0716855	20.32
Hispanic	0.7005267	0.0397291	17.63
Native American	0.9852397	0.2185276	4.51
Othrace	0.3578987	0.0690812	5.18
Small Hospital	-0.2306307	0.0271089	-8.51
Large Hospital	0.4086962	0.0187934	21.75
Rural	-0.2571079	0.0287087	-8.96
Urban Teaching	0.4435332	0.0285431	15.54
Midwest	-1.379444	0.0285365	-48.34
South	-1.266695	0.0304886	-41.55
West	-1.405585	0.0331301	-42.43
Gov't, private collapsed	0.1321539	0.0394499	3.35
Gov't, nonfederal	0.0298989	0.03728	0.8
Private, Nonprofit	0.1144622	0.0276962	4.13
Private, Other	-0.0964906	0.0529956	-1.82
AnticipateBBA	0.5005927	0.0350819	14.27
Transfer	1.959608	0.0323323	60.61
Pilot DRGs			
DRG 113	5.011057	0.1329439	37.69
DRG 209	-0.4522222	0.0449972	-10.05
DRG 210	0.6615885	0.0791664	8.36
DRG 211	-0.8668984	0.1414605	-6.13
DRG 236	2.074409	0.1003959	20.66
DRG 263	3.870951	0.142395	27.18
DRG 264	0.8417361	0.3020502	2.79
DRG 429	3.473088	0.0835828	41.55
DRG 483	28.2672	0.1635485	172.84
Non-Pilot DRGs			
DRG79	2.838557	0.0543394	52.24
DRG 106	4.530134	0.1098165	41.25
DRG 107	3.673871	0.0592497	62.01
DRG 148	4.666528	0.048742	95.74
DRG 239	0.4904026	0.0788239	6.22
DRG 243	-0.7249462	0.059642	-12.15
DRG 296	-0.7113796	0.0429895	-16.55
DRG 415	5.739618	0.1034411	55.49
DRG 468	4.179264	0.0773575	54.03
Pilot DRGs			
AnticipateBBADRG113Tran	-0.860659	0.1486551	-5.79
AnticipateBBADRG209Tran	-1.391769	0.0519429	-26.79
AnticipateBBADRG210Tran	-1.015026	0.0866211	-11.72
AnticipateBBADRG211Tran	-1.203076	0.1575297	-7.64
AnticipateBBADRG236Tran	-2.161365	0.115032	-18.79
AnticipateBBADRG263Tran	0.7068817	0.1724675	4.1
AnticipateBBADRG264Tran	-0.9264337	0.4051676	-2.29
AnticipateBBADRG429Tran	-1.078106	0.1045096	-10.32
AnticipateBBADRG483Tran	4.101564	0.180587	22.71
Non-Pilot DRGs			
AnticipateBBADRG79Tran	-0.5118546	0.066376	-7.71
AnticipateBBADRG106Tran	0.359401	0.2322647	1.55
AnticipateBBADRG107Tran	0.8217474	0.0831027	9.89
AnticipateBBADRG148Tran	2.390839	0.0693938	34.45
AnticipateBBADRG239Tran	-0.7199296	0.1001874	-7.19
AnticipateBBADRG243Tran	-0.3749561	0.082482	-4.55
AnticipateBBADRG296Tran	0.0045345	0.0573788	0.08
AnticipateBBADRG415Tran	2.131692	0.1311388	16.26
AnticipateBBADRG468Tran	3.942784	0.1052317	37.47

N=717784
F=5845.21
R^2 =.3132

Table 3.21
Geometric Mean Length of Stays, by DRG

Non-Pilot DRGs			*Pilot DRGs*		
DRG	FY	GLOS-1	DRG	FY	GLOS-1
1	1998	6.2	14	1998	4.1
	1999	5.8		1999	3.9
	2000	5.5		2000	3.7
	2001	5.3		2001	3.7
79	1998	5.8	113	1998	8.7
	1999	5.7		1999	8.8
	2000	6.8		2000	8.5
	2001	5.6		2001	8.8
106	1998	8.8	209	1998	4.3
	1999	8.1		1999	3.9
	2000	8.1		2000	3.6
	2001	8.3		2001	3.6
107	1998	6.3	210	1998	5.5
	1999	8.5		1999	5.1
	2000	7.3		2000	4.9
	2001	8.2		2001	5
148	1998	9.6	211	1998	4
	1999	9.3		1999	3.7
	2000	9.1		2000	3.5
	2001	9.1		2001	3.5
239	1998	4.3	236	1998	3.3
	1999	4		1999	3.1
	2000	3.9		2000	2.9
	2001	3.9		2001	3
243	1998	3	263	1998	7.9
	1999	2.8		1999	7.8
	2000	2.7		2000	7.7
	2001	2.7		2001	7.9
296	1998	3.3	264	1998	4.4
	1999	3.1		1999	4.4
	2000	3		2000	4.3
	2001	3		2001	4.4
415	1998	9.8	429	1998	4.4
	1999	9.5		1999	4.2
	2000	9.3		2000	3.9
	2001	9.4		2001	3.9
468	1998	8.9	483	1998	32.8
	1999	8.5		1999	33
	2000	3.7		2000	32
	2001	8.2		2001	32.7

Table 3.22
Regression Results, Equation 3
Conditional on Pilot DRG Status and Shortstay=1
Dependent Variable: Length of Stay

	Pilot DRGs	t-value	Non-Pilot DRGs	t-value	Difference (Pilot-Nonpilot)
Constant	4.286094	47.8	7.759466	112.15	-3.473372
Age	-0.0122887	-13	-0.0432801	-55.24	0.0309914
Female	-0.2580329	-17.01	-0.3802172	-32.3	0.1221843
Black	0.6110804	20.36	-0.3580709	-14.4	0.9691513
Hispanic	0.4672971	12.53	-0.0576622	-2.01	0.5249593
Asian	0.7859046	10.67	-0.1100766	-2.23	0.8959812
Native American	0.3375564	1.61	-0.1908135	-1.32	0.5283699
Other Race	0.3361966	5.06	0.2395051	4.76	0.0966915
Small Hospital	-0.1532605	-6.48	-0.200101	-10.36	0.0468405
Large Hospital	0.1424897	8.52	0.1970731	14.5	-0.0545834
Rural	-0.2119327	-8.06	-0.4388743	-21.63	0.2269416
Urban Teaching	0.3124029	11.82	0.2203862	10.22	0.0920167
Midwest	-0.0713592	-2.72	-0.0360802	-1.69	-0.035279
South	-0.0205179	-0.71	0.0002945	0.01	-0.0208124
West	-0.184903	-6.07	-0.3496312	-14.38	0.1647282
Gov't Private	-0.0965764	-2.7	-0.0147217	-0.51	-0.0818547
Gov't Nonfederal	-0.2106122	-6.53	0.1290495	4.88	-0.3396617
Private Profit	-0.1230282	-5.08	0.1627402	8.16	-0.2857684
Private Other	-0.0034371	-0.07	0.1759821	4.78	-0.1794192
PostBBA	-0.0645377	-1.54	-0.2249324	-10.13	0.1603947
Transfer	0.8671496	19.71	0.5020113	16.92	0.3651383
PostBBATransfer	0.0388291	0.82	-0.0130525	-0.41	0.0518816
N=201521			N=144425		
F=219.72			F=390.83		
R^2 = .0224			R^2 =.0538		

Table 3.23
Regression Results, Interacted Variables
Dependent Variable: Length of Stay
Constant: 13.34066

	Non-interacted Variables			Interacted Variables			
	Coefficient	SE	t-value	Coefficient	SE	t-value	F-value
Age	-0.0677853	0.0018854	-35.95	0.0701852	0.0025273	27.77	771.22
Female	-0.4957579	0.0287363	-17.25	-0.3532893	0.0394877	-8.95	80.05
Black	1.185418	0.0549263	21.58	0.7827472	0.074988	10.44	108.96
Hispanic	0.8223091	0.0678504	12.12	0.4539744	0.0937006	4.84	23.47
Asian	1.609632	0.1176618	13.68	0.7973012	0.1690234	4.72	22.25
Native American	0.9605591	0.3619202	2.65	0.1741229	0.5154376	0.34	0.11
Other Race	0.3427399	0.12011	2.85	0.6352939	0.1634316	3.89	15.11
Small Hospital	-0.4885673	0.048093	-10.16	0.0989409	0.0643517	1.54	2.36
Large Hospital	0.7274333	0.0330894	21.98	-0.1630431	0.0444986	-3.66	13.42
Rural	-0.9946487	0.0498648	-19.95	0.6078126	0.0677767	8.97	80.42
Urban Teaching	0.6117698	0.050326	12.16	0.4235003	0.0676166	6.26	39.23
Midwest	-1.342449	0.0504098	-26.63	-0.5769042	0.0676228	-8.53	72.78
South	-0.8741636	0.0529938	-16.5	-1.049018	0.072156	-14.54	211.36
West	-1.401118	0.058164	-24.09	-0.554491	0.0786725	-7.05	49.68
Gov't Private	-0.0350527	0.0645846	-0.54	-0.0871548	0.0868277	-1	1.01
Gov't Nonfederal	-0.1336495	0.0603486	-2.21	0.0182819	0.0807092	0.23	0.05
Private Profit	-0.2432264	0.0487323	-4.99	0.4157718	0.0656646	6.33	40.09
Private Other	-0.2498111	0.0885314	-2.82	0.0319382	0.1181994	0.27	0.07
PostBBA	-0.0339897	0.0627775	-0.54	0.1017991	0.1025575	0.99	0.99
Transfer	2.770516	0.0765251	36.2	-0.0767122	0.1222629	-0.63	145.26
PostBBATransfer	0.3628567	0.0820666	4.42	-1.372059	0.1138401	-12.05	0.39
PilotDRG	-5.773713	0.2344681	-24.62				

Note: Interacted variable=pilotdrg*variable i
N=729519
F=806.70
R^2=0.0454

Chapter 4
Conclusion

Obesity and Wages

The research contained in this dissertation touched on different topics within the field of health economics. The first paper, "An Economic Analysis of Obesity on Wages," examined the effects of overweight and obesity on wage income, improving on previous research by using a dataset—the 2000 Medical Expenditure Panel Survey—with more detailed health conditions and industry and occupation variables. In the dataset used in this essay, 35% of the observations in this dataset are overweight and 16% of the observations represent obese persons. In total, 51% of the observations in this dataset are over what is recognized as a healthy weight.

As discussed in the essay, the results are noteworthy because they appear to contradict previous research on this topic. Three sets of regressions were run. In the first set, wages for the year 2000 were regressed on demographic variables, health, industry and occupation variables, and dummy variables based on BMI. These results were interesting, because it appears that, relative to women who are within a normal weight range, overweight women experience only a very slight—and statistically insignificant—wage penalty of 1.8%, and obese women experience a higher wage penalty of just under 4%, but this is again not statistically significant.

Interacting the overweight and obese dummy variables with each industry and occupational variable, as done in the other two sets of regressions, yields the most interesting results. While being overweight hurts men in certain occupation categories, being overweight does not significantly hurt women. Furthermore, being obese hurts both men and women. For men, only those working in entertainment are significantly hurt, as obese men had wages 44% less (after adjustment) relative to non-obese men. The entertainment and sales industries were not kind to the wages of obese women, with obese women earning 15% less in the sales industry and 34% less, after adjustment, in the entertainment industry relative to non-obese women.

Policy Implications for Obesity

Perhaps one of the most important questions for economists to ponder is, is there a role for government with regards to obesity? As mentioned at the outset, excess body weights is associated with chronic illness and, if overweight individuals consume more health care, financial externalities exist, particularly if the health care is publicly financed.

Economists and any professional with an interest in public health must continue to ask important questions about obesity. With regards to the labor market, the obvious question is: Why would overweight and obesity impact wages? Overweight individuals (those with BMI from 24-29) and obese individuals (those with BMI of at least 30) could face discrimination in the labor market. If excess weight contributes to ill health, then those workers could be less productive than less heavy (and less sick) workers. Last, if individuals have excess weight because of a lack of motivation to exercise, then it is possible for those individuals to sort themselves into certain jobs.

So, what is the role for government to play? In order to answer that question, it is important to realize the complexity of this issue. Obesity is not just an issue of overeating, but it also encompasses education issues, agricultural and food manufacturing and marketing issues, and urban planning. Governmental policies and programs affect many of the environmental determinants of poor diets and sedentary lifestyles. For example, USDA's Food and Nutrition Service (FNS) funds and oversees federal food assistance programs, such as the Food Stamp Program, the National School Lunch and Breakfast Programs, and the Special Supplemental Nutrition Program for Women, Infants, and Children (www.fns.usda.gov).

Communities, workplaces, schools, medical centers, and many other venues are subject to federal and other governmental regulations that could be modified to make the environment more conducive to healthful diet and activity patterns. Therefore, government can intervene in many ways. Discussion of possible future governmental programs is beyond the scope of this paper, but intervention could be in the form of education programs, refinement of food labels, and pedestrian friendly urban planning.

Medicare

The second essay, "An Economic Analysis of the Impact on Health Care of Certain Medicare Provisions of the Balanced Budget Act of 1997," examined the effect of the Post Acute Care Transfer Policy, as laid out in the Balanced Budget Act of 1997, on the lengths of stay of certain Medicare patients. The Medicare provisions of the Balanced Budget Act were a result of concern about the financial health of the Medicare program. Hospital payments for patients transferred to post acute care were targeted because of the possibility that patients were being transferred “too soon”, with hospitals effectively receiving excess payment.

As outlined in the essay, the dataset used in this analysis is the Healthcare Cost and Utilization Project (HCUP), administered by the Agency for Healthcare Research and Quality (AHRQ). This dataset, covering the years 1998-2000, contains information on diagnoses, patient demographics and basic hospital characteristics. The final sample used in this study includes only patients age 65 and older, listing Medicare as the primary payer, discharged alive, that fall under one of the 20 DRGs considered for or included in the policy.

A variety of regressions were run, from the general to the more specific. Regressions included interaction variables to estimate the effects of DRG category and discharge date on length of stay. The initial regressions yielded results that were not entirely expected given the intent of the policy. That is, it was expected that the interaction variables—PostBBAPilot—would have a positive and significant coefficient, reflecting the idea that hospitals would no longer have the financial incentive to discharge patients early who were grouped into the 10 “pilot” DRGs. On the other hand, the early results were likely reflective of lack of specificity. Regressions addressed the issue of timing, transfer status and finally the “short stay” patients, those with lengths of stay that are at least 1 day less than the geometric mean length of stay for that DRG in a fiscal year (which, for the federal government, begins October 1). In analyzing these patients, the data show that the lengths of stay for patients that were grouped into the pilot DRGs and were transferred after 10/01/98 did not increase. This is not consistent with the aim of this policy.

Policy Implications for Medicare

The continuing rise of health care and Medicare costs and the increased longevity of the population mean that the financial health of Medicare needs to be strengthened if the program is to continue protecting beneficiaries from the cost of health care.

For example, the baby boom generation, about 76 million people born between 1946 and 1964, will contribute significantly to the growth in the number of elderly individuals who need medical care the amount of resources required to pay for it (General Accountability Office 2003). In 2011, the first of the baby boomers, a generation numbering 78.2 million as of 2005, will turn 65 years old, becoming eligible for Medicare. The first baby boomers reach age 85 in 2030. In 2000, individuals aged 65 or older made up 12.7 percent of our nation's total population. By 2020, that percentage will increase by nearly one third to 16.5 percent--one in six Americans--and will represent nearly 20 million more seniors than there are today. By 2040, the numbers of seniors aged 85 years is expected to be 14 million (www.census.gov).

As Medicare spending increases over time, the program's premium amounts will continue to rise as well. As mentioned in the essay, between 2003 and 2007, the monthly Part B premium increased to $93.50 per month (www.cms.hhs.gov). The premium increases have been especially high in recent years, due in part to provider payment increases and the growth of Part B drug spending.

In addition, significant coverage gaps remain: Medicare provides limited coverage of certain health care services, including mental health, long-term care, vision, hearing, and dental care. As technology and other health care costs continue to rise, it could become increasingly difficult for beneficiaries to afford the costs of Medicare's premiums and cost-sharing, as well as the costs of services that Medicare does not cover.

According to the Government Accountability Office (2003), long-term budget simulations continue to show that, in the absence of entitlement or significant fiscal reform, demographic trends and rising health care spending will drive escalating federal deficits and debt. Just as physicians take the Hippocratic Oath to "do no harm," policymakers should avoid adopting reforms that will worsen Medicare's long-term financial health.

Ultimately, broader health care reforms must be considered, as problems with growth in spending are not exclusive to Medicare. For both public and private payers, containing growth in health expenditures will be a 21st century challenge. Potential policies for financially strengthening Medicare include reducing provider payments, reducing Medicare benefits, increasing the eligibility age, increasing payroll taxes, or increasing beneficiary premiums. Combinations of these tools are also possible.

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