THE EFFECT OF MEDICAL MALPRACTICE AWARD AMOUNT ON HEALTH:

A CROSS-SECTIONAL REVIEW OF 1998 STATE DATA

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Jason Margretz, son of James and Susan Margretz was born October 15, 1978, in Cedar Rapids, Iowa. He graduated from Luther College in May 2001 with a double major of Management Information Systems and Management along with a minor in Economics. After graduation, he worked as a computer programmer for a Fortune 500 insurance company for 3.5 years. He then entered the Graduate School of Auburn University in August, 2005.

THESIS ABSTRACT

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This thesis examines the relationship between amount awarded in medical malpractice lawsuits and the health of a population. Data from 1998 is collected for each state and a crossectional analysis is performed. Two stage least squares is used to compensate for the simultaneity between health and the amount awarded in medical malpractice lawsuits. Although lacking statistical significance, analysis of the results supports the theory that medical malpractice lawsuits at the margin improve the health of a population.

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Health has always been a highly valued asset. In earlier times good health was a requirement for survival. Today, in the developed world, people may live productive lives with some of the most debilitating medical disabilities. There are efforts to protect physically debilitated workers from employment discrimination, such as the Americans with Disabilities Act (ADA). Buildings are designed to be accessible to individuals with disabilities. There are companies that provide opportunities for sports and recreation for disadvantaged individuals. With these new opportunities good health is no longer a requirement for survival; it is now a luxury and facilitator. Good health is not required to have a productive life, but it does increase the choice of available careers. It is not needed for a long life, but does increase its likelihood. Good health may not directly provide enjoyment, but it allows for a pain free existence and it enables more choices of recreation. Citizens in developed countries are experiencing expected lifespans that are more than twice as long as people from earlier civilizations. Because of the increased lifespans there has been a drastic increase in the expectation of how long people with chronic pain or other ailments will have to endure suffering. When the populace looks to increase or maintain their health it is medical care providers that they seek out.

Medical care providers have been around since the beginning of recorded history. Unfortunately, not all medical outcomes are positive. These negative outcomes can be broken up into two generic categories; where there is no fault of the medical worker, and where the negative outcome is at least partially based on a mistake of the provider. Newer technology and further understanding of medicine reduces the number of no fault negative outcomes, but the primary interest of this thesis is how legislative action against medical care professionals when mistakes do occur effects health.

The following chapter provides a brief overview of the history of medical malpractice. It shows how over time and across cultures medical malpractice is treated differently. There are differences in how medical malpractice is determined and what is viewed as an appropriate deterrent or compensation for the injured party. Furthermore, it examines the perception towards medical malpractice and the ensuing lawsuits in the United States.

Chapter III will examine contain the literature review. The chapter will start by examining the theory behind medical malpractice lawsuits. The theory will be clarified, expanded, and examples given. Finally, studies providing a foundation for the regression analysis to follow will be discussed.

Chapter IV will discuss the model being used and a rational for the variables being utilized. Variables that affect the design of the model will be noted.

In Chapter V, more detail is given to sources and more specific meanings of the variables being employed. After the variables have been adequately defined, the regression models will be presented.

Chapter VI, will present the results of the regressions. Initially, tests to insure the second stage regression is correctly specified, whether heteroscedasticity exists, and the extent of multicollinearity will be performed. The results of the regression will be examined for economic and statistical significance.

The final chapter will summarize the results found in the econometric analysis. It will suggest further research topics that were either opened up by this thesis or may improve the quality of the findings.

CHAPTER II

BACKGROUND OF MEDICAL MALPRACTICE LAW

The first handling of medical malpractice occurred in the first recorded set of laws. During the second century B.C. the Babylonian legal code of Hammurabi had predefined punishment for mistakes by medical care providers. These laws did not compensate victims of the malpractice, but they did discourage mistakes by doctors.

As time has progressed, different civilizations have had varying expectations of medical providers and punishment for mistakes have changed. A variety of factors play a roll in expectations. Different societies have different concepts of justice and compensation. Furthermore, the faith in medicine to cure also plays a role. It is this faith in medicine that is especially high in modern developed countries, although there is variance in this faith across countries and even within different regions of the same country. It is beyond doubt that medicine has made great strides and that some faith is justified. Whether the faith in medicine has exceeded its capabilities is an open debate.

Eighteenth century English law relied less on predefined punishment for medical mistakes and on more financially punishing liable practitioners by awarding injured patients compensation. According to Mohr (2000), by the beginning of the 18th century the notion of malpractice was embedded in English legal theory.

The theories developed in England were influential in the colonial United States. The first recorded malpractice lawsuit in the United States occurred in 1794 involved a man suing as a result of his wife's death due to surgery. According to DeVille (1990), after 1835 medical malpractice lawsuits started becoming popular and by the 1840s there were complaints from physicians about the common occurrence of malpractice lawsuits. Since this time, medical malpractice lawsuits have been viewed as a problem by some. The amount of attention medical malpractice lawsuits receive from the media and politicians varies, but it seems that the debate on medical malpractice is never far from the surface.

Mohr cites the initial lack of a governing body to regulate professionals as the chief reason for the increased popularity in the United States relative to England and the rest of Europe. Without the governing body the quality of care varied more dramatically and the advertisement of medical care and products often exaggerated the results that could be expected. However, as these issues have since been resolved it is necessary to look for other causes.

Theory states that one of the reasons for a large number of medical malpractice lawsuits in the United States may be because of the acceptance of contingency based legal fees in the United States. Contingency based fees assuming an open market place, potentially allow for greater access to the court system and a higher alignment of financial motivation between the lawyer and client.

Other reasons such as new technology, higher standards, and the advent of malpractice insurance also contribute to the number of lawsuits and award amounts. Although in these areas there have traditionally been fewer differences between the United States and Europe.

ANALYSIS OF MEDICAL MALPRACTICE LAWSUITS

According to Olsen (1996), there are three main measures of medical malpractice lawsuits that determine financial impact on malpractice insurers. Their *frequency* measures how often medical malpractice lawsuits occur. The percentage of lawsuits that are decided in the favor of the plaintiff can be viewed as the *probability* of a defendant losing a malpractice suit. Finally, the *severity* is the average amount awarded. These three factors determine the average benefits paid be medical malpractice insurers. And, assuming a competitive insurance market, the average benefits paid should be a decisive factor in determining the premiums paid by medical care providers. The frequency and severity of lawsuits are the two components that supporters of tort reform or specific medical malpractice reform cite as being problems.

The debate on medical malpractice is a large, multifaceted dispute. Many of the arguments used by both sides are flawed, biased, and misleading. This is to be expected because so many lives are directly and indirectly affected. Doctors, lawyers, insurance companies, patients and their families are all affected. Because there are so many parties and, as a result, so many faulty arguments, it is futile to attempt to examine the logic of every argument and counter argument.

Tort law has two objectives. One is to compensate the injured, and the other, just like other forms of law, is designed to modify actions. It is the modification of actions that is most often used as arguments for and against medical malpractice lawsuits. Opponents of medical malpractice lawsuits believe that the actions are changed too much. They believe that because of medical malpractice lawsuits doctors leave the profession, access to care is limited, and defensive medicine is practiced. Proponents of

medical malpractice believe that the change in actions has a positive net benefit to society.

Despite the futility of examining arguments from nonacademic parties (physicians, patients, lawyers, etc.) this study would be remiss not to examine existing economic theory which will be covered in the literature review. The results of previous research are reviewed. Then an empirical analysis are preformed that provide better insight into how the evidence corresponds to theory. Specifically, this thesis examines the connection between health and medical malpractice lawsuits.

When examining health and medical malpractice it is important to recognize the simultaneity that exists between the two variables. Medical malpractice lawsuits and the risk of being sued affect the quantity, cost, and variety of services provided. All of this theoretically changes the health of the population, although it is not known if the net affect is positive or negative. The frequency, probability, and severity of benefits paid may affect health differently depending on what information medical care providers are exposed to and how it affects their decisions.

The other way of viewing the relationship between health and medical malpractice lawsuits is attempting to determine how health affects the number and severity of medical malpractice lawsuits. Medical care providers, jury, and patient health all play a role in medical malpractice lawsuits.

It is reasonable to suspect that medical care providers are more likely to make a mistake if they are in poor health when treating a patient. The more likely a mistake is made increases the liklihood a lawsuit will be initiated, thereby increasing the frequency of lawsuits and potentially affecting the probability of a decision in favor of the plaintiff.

It is also possible that these physicians when making a mistake commit a more serious one and the severity of the lawsuits increase.

The health of the jury and the health of their friends and family may affect their ability to empathize with the plaintiff. This would not directly affect the frequency of lawsuits, but would affect the probability of an outcome favoring the plaintiff and the severity of the decision. An increase in these two factors would likely increase future frequency of lawsuits.

Analyzing the affect of the patient's health is the most complicated. A patient that had relatively poor health may require more complicated diagnoses and treatments which increase the likelihood of a mistake, thereby increasing the frequency of lawsuits. Furthermore, a mistake on an unhealthy individual may produce a more negative outcome. An initially unhealthy individual may require a longer recovery. Both of these reasons may increase the severity of the outcome. Depending on the circumstances and disposition of the jury, an unhealthy individual may have a harder time convincing a jury that the medical care provider made a mistake and the negative outcome was not a result of their generally poor health. A patient of relatively good health may be able to recover more quickly from any medical malpractice that occurs. A contrarian view is that a person of good health is likely to have a more productive outlook before the medical treatment; therefore, a mistake that leaves a healthy and unhealthy patient in the same condition would be more expensive to the healthy patient. The increased expense would then be reflected in the severity of the outcome. The increased damage done to the healthy patient may increase the frequency of lawsuits. Because there is rational supporting health both increasing and decreasing the severity of medical malpractice lawsuits it is not possible to make a definite prediction of what should happen.

The health of patients, medical care providers, and juries each affect the frequency and severity of the amount awarded in medical malpractice lawsuits. Ideally, there would be data on each of these groups. It could then be determined how the health of each group affected medical malpractice awards. Unfortunately, the data required is not available. The coefficient of the health variable is affected by each of these groups. This makes interpretation of the data more difficult.

Frequency, probability, and severity all play a role in the importance of medical malpractice. However, it is the severity, or amount awarded by the jury, that gets the most attention. Part of this is because it also has an affect on the frequency of lawsuits according to medical malpractice critics. Large award amounts create a "lottery" mentality.[1] Because of the importance and attention received by the amount awarded, it is the focal point of this thesis in measuring medical malpractice.

Examining the populations health and medical malpractice award amounts is expected to provide the clearest understanding of the relationship between the two. Once this relationship is better understood it can be used to improve understanding of the topic and contribute towards implementation of sound public policy. The affect of medical malpractice award amounts on health of the population can help determine policy implementation towards medical malpractice, assuming that health is a priority of the government. Meanwhile examining the determinates of medical malpractice awards, specifically the role health plays, will explain some of the variation found in the data.

[1] As given in a speech by Donald J. Palmisano, MD, JD Past-President of American Medical Association on February 17, 2005 to the House of Representatives Small Business Committee

CHAPTER III

LITERATURE REVIEW

This literature review contains two parts. The first part examines the theory of medical malpractice lawsuits. The second part reviews previous papers that are used to help formulate the regression models to be estimated late on in this study.

MEDICAL MALPRACTICE THEORY:

Because medical malpractice lawsuits fall under the more general category of tort law, it is important to understand the origins and rationale behind tort law.

According to Landes and Posner (1987), tort law, although around since the twelfth century, were initially a relatively unimportant field because few of the cases involved accidents. This changed in the middle of the nineteenth century. Railroads obtain much of the credit for the increase in the number of tort cases involving accidents; however, as pointed out by Olsen (1996), this is also when medical malpractice lawsuits started becoming more popular.

The economic theory of tort law revolves around the concept that some activities have external costs. An example often used is that railroads may produce sparks that damage the nearby crops of a farmer. The more trains the railroad has pass by a given

farm, the greater the chance of damage to the farm. Tort law allows for a method of internalizing those costs, thereby reaching a more efficient solution. Although tort law is a potential solution, it is not the only available solution. Another popular solution is taxing the railroad and compensating affected farmers.

Coase (1960) points out the problem is actually reciprocal in nature. Continuing the example above, sparks from the railroad hurt the farmer. But taxing or regulating the railroad harms the railroad. Both parties may have options available to them that would eliminate the conflict. When no transaction costs are assumed then the parties will reach the same outcome reguardless of whether one of the parties is held liabale for damages. However; when the assumption of no transaction costs is relaxed, the initial state of liability laws and predefined property rights may affect the outcome and hence, may affect the efficiency of the outcome.

A numerical example is the easiest way to see the point. Suppose that the farmer makes $100 from a crop that is susceptible to fire damage from sparks and $90 from a crop that is fire resistant. There is an expected fire cost of $30 if the crop susceptible to fire is grown. The railroad company can install a spark free smokestack for $20. Transaction costs of predamage negotiation between the railroad company and the farmer is $15. There are three options available to the railroad under the assumption that it is held responsible for damages. One option is to let the sparks start the crop on fire and pay $30 to the farmer. The second option is to negotiate with the farmer prior to the fire damage. This option would result in costing the $15 in transaction costs and an additional $10 to have the farmer plant a fire resistant crop for a total cost of $25. The

final option is for the railroad company to install the spark free smokestack for $20. Given these three options the most efficient solution is to install the smokestack for $20. However if the railroad is not held responsible for damages then the farmers most efficient option is to plant the fire resistant crop and only lose $10. In this example if the railroad company is held liable for damages then society (limiting society to the railroad company and the farmer for simplification) will have $10 less than if the railroad was not held responsible.

As analyzed by Landes and Posner, *No Liability*, *Strict Liability*, and *Negligence* are different ways for courts to assign liability. Applying "No Liability" to medical malpractice lawsuits prevents hospitals and physicians from being held responsible. This is the most economically efficient solution if patients are more efficient at avoiding injury than hospitals are at preventing injuries. Given the expertise and education involved in being a medical professional, this is an unrealistic expectation in the vast majority of cases. "Strict Liability" states that every accident is the responsibility of the injurer. In the case of medical malpractice the medical care professional is held responsible for every negative outcome. This differs from "Negligence" in that the injurer is only held responsible if they use less than "Due Care". (Where "Due Care" is defined as the point where social marginal cost and social marginal benefits are equal) The subsequent analysis, shows that strict liability and negligence both result in the potential injurers, medical care providers, having an optimal level of care at the "due care" level. Although the quality of health care should be the same if negligence or strict liability is assumed, the different forms of liability should affect the cost of health care. If medical care

providers are required to pay for all negative outcomes then they need to charge more to be compensated for the claims they pay. The total expected cost of health care may be the same for patients, but the upfront cost is higher, this leads to a reduction in the amount of medical care, and hence a reduction in quality of health.

Medical malpractice follows the negligence requirements of tort law. As mentioned above, negligence only occurs if due care is not provided, but the medical care profession has incentive to provide due care. Yet many medical malpractice cases occur. There are several reasons why this may happen. 1.) Patients and or juries may mistakenly believe that there was negligence. 2.) A person may not have complete control over the level of care they provide due to a stochastic element such as attentiveness. 3.) Negligence is determined by the actions expected of an "average man". (Below average individuals may have a harder time meeting these expectations.) 4.) If there are a lack of negligence cases, there enters doubt about potential outcomes and what is considered due care. The frequency of medical malpractice lawsuits seems to suggest that lack of cases is not the cause of existing medical malpractice lawsuits. Medical care professionals often cite the first reason, while patients and their lawyers are more likely to cite 2 or 3 as being the cause of medical malpractice lawsuits.

The theory above gave the economic justification for medical malpractice lawsuits and why they occur. Understanding these factors is necessary but not sufficient to properly understand the debate on medical malpractice. The amount awarded in a case gets perhaps more attention and blame, by the medical community, than the number of cases. According to the past president of the AMA, Donald J. Palmisano, "runaway

juries are handing out huge awards in some liability cases" which "has created a lottery mentality".[2] A lottery mentality in this context is where plaintiffs sue with little chance of winning in hopes that they will win and receive a large windfall. Therefore, it is also important to understand why there have been "huge awards".

According to Landes and Posner (1960), punitive damages are when the amount awarded exceeds the harm done. Punitive damages are awarded to encourage the party committing the transgression or mistake and other similar providers to take steps to prevent it or similar occurrences from happening again. Punitive damages are sometimes awarded as a substitute for an injunction in cases involving the human body. This is because enforcing property rights through an injunction is likely to be prohibitively expensive. A more efficient manor of dealing with the problem is by awarding punitive damages and providing the injurer the financial incentive to change their behavior.

When physicians and other medical care providers change their behavior it is referred to as defensive medicine. Although defensive medicine is used in a negative context, Bhat (2001) points out that defensive medicine can either raise or lower the quality of medical care. He goes further to state that raising the quality of medical care is good and lowering the quality or medical care is bad. Economically this is a little to broad of a definition. It is possible that running extra tests would raise the quality of care, but at too high of a cost and this would be inefficient. The quality of medical care may be very high, but if the quality leads to a price higher than people are willing to pay then it becomes irrelevant. Hence, systematically inefficient use of medical resources

[2] Speech to the House of Representatives Small Business Committee on February 17, 2005

may result in excessively high prices leading to lower quantity of medical care and lower overall health of the population.

Kessler and McClellan (1996) examined elderly patients with heart diseases in states that implemented tort reform and compared the results to states that did not have tort reform. They determined that there was a five to nine percentage drop in expenditures with an insignificant drop in mortality rates. Their conclusion is that there is evidence to support the argument that there is an inefficient use of resources in medicine that can be in part corrected by tort reform.

Bhat (2001) proposes that there may be excessive defensive medicine being practiced but this may not disappear with the elimination of malpractice risk because a significant fraction of physicians' income comes from the practice of defensive medicine. Furthermore, if malpractice risks are eliminated, then "negligent adverse outcomes are likely to go up dramatically."[3]

Vidmar (1995) points out that although juries determine the verdict and the damage award; these are reviewed by the judge who may determine that the jury made a mistake. Furthermore, "either of the opposing parties may appeal the decision for review by a higher court." Vidmar provides a very detailed history of one case, *Melis V. Kutin*, on how a jury and judge determine the damage awarded.

Riccardi and Ireland (2000) provide information on how the payment and fee structure of medical malpractice cases are determined. In the process they discuss how malpractice amounts are determined in New York. Every state determines the amount

[3] p. 198

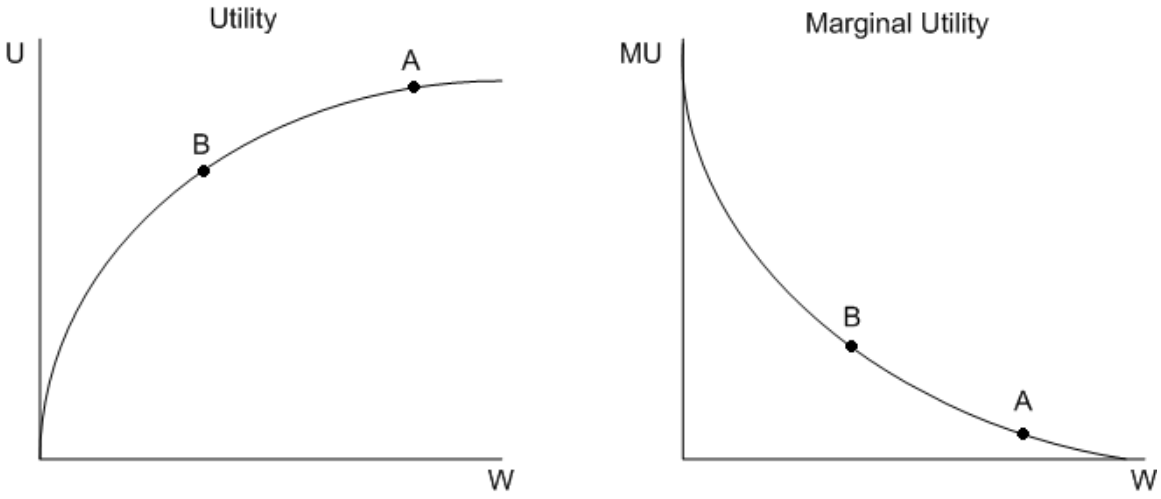
awarded differently but they take the same issues into consideration. When determining what variables should be included in the regression of medical malpractice amount awarded this should provide a solid foundation. The damage award is comprised of economic damages and noneconomic damages categories. Economists often play a large role in determining the economic damages to the patient. Economic damages include lost past and future wages, medical bills, and other monetary losses that directly result from the medical malpractice. Economists do not play a part in determining noneconomic damages, which include such things as pain and suffering, loss of enjoyment, loss to society, etc. In New York, and other states, the damages are often broken into life contingent and period certain payments. The actual amount of life contingent payments may vary significantly with the amount determined by the court. This discrepancy results from many patients that experience medical malpractice have shorter life expectancies.

Pain and suffering along with loss of enjoyment will vary depending on the extent of the injuries. Different medical treatments have different likelihoods of resulting in serious injury to the patient. Because there is likely to be a positive correlation between economic damages and damages resulting from pain, suffering, and loss of enjoyment, procedures can not be categorized as solely affecting economic or noneconomic damages. Fournier and McInnes (2001) examined different specialties that may increase the risk of medical malpractice lawsuits. They determined that Anesthesiology, Obstetrics-Gynecology, Otorhinolaryngology, General Surgery, Emergency Medicine, and Radiology all may increase the chances of a medical malpractice lawsuit.

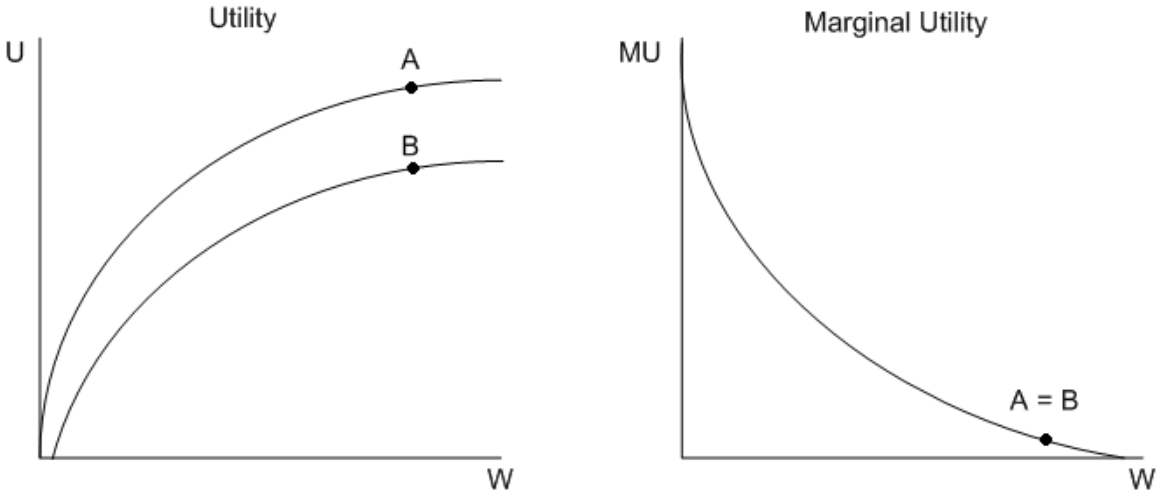
Another aspect of noneconomic damages is loss to society. Although other aspects of a patient may affect the loss to society, education, as stated by Thompson (1998), can have a dramatic effect. In fact, according to Haveman and Wolfe (1984), "a conservative estimate of the total annual value of the nonmarketed effects of schooling would be, say, $4500-55000."[4]

Rubin (1993) examines alternatives to existing tort law. In the process of doing so, he states that pecuniary (economic) and nonpecuniary (noneconomic) losses have different effects on the patients' utility functions. State dependent utility may be an old concept but there is not much gained by using a more complicated theory. Pecuniary losses can be represented by wealth in the utility function. Specifically, pecuniary loss results in a movement along the utility curve (from point A to point B as graphed below). The marginal utility of wealth is believed to be positive but decreasing for most consumers. Therefore, a pecuniary loss results in lower utility but higher marginal utility.

[4] p. 400



Nonpercuniary losses lower the utility curve. A change in utility curve may result in the same marginal utility or a lower one, but is not expected to result in higher marginal utility of wealth.



The above graph depicts a nonpecuniary loss where the utility is lowered but the marginal utility of wealth remains unchanged, hence the utility curves are parallel.

Appling the work done by Rubin, the sources of noneconomic damages in medical malpractice lawsuits can be very informative. According to Sinn (2003), "Prefrences are, in fact, just a trick of nature to induce us to behave in a way that satisfies the rules of biological evolution." Sinn looks at risk prefrences from a biological perspective and proves that logarithmic risk preferences are statistically superior to all other preference structures. That is to say that logarithmic preference structures will, "be chosen by a fraction of the aggregate population that approaches 100% as time goes to infinity." This conclusion is reached by recognizing that evolution selects the preference structure that maximizes the growth rate of a population. Sinn then makes an assumption that the number of children a parent has is proportional to the amount of resources commanded. It should be noted that this need not be the current case, simply that for much of mankind's history it was applicable. The assumption that the number of children a parent has is proportional to the amount of resources commanded is contentious. He goes on to prove that a logarithmic preference structure will maximize wealth in the long run. The basic rational is that a more risk adverse individual will place too many limits on their growth, while a more risk loving individual experiences too many significant negative outcomes to maximize their long term wealth. The concept of a logarithmic utility curve has a long history dating back to 1754 when it was first proposed by Bernoulli.[5]

Although it would be a mistake to assume that everyone has this utility function, a logarithmic utility function should suffice as a rough representation of the public's utility.

[5] Specimen Theoriae Novae de Mensura Sortis translated in Econometrica p. 28

For simplicity I will assume that the original utility function can be represented by U = ln(w) where 'w' represents wealth. There are three basic types of losses that will be examined: economic loss, noneconomic loss that maintains the same marginal utility slope, and noneconomic loss with a lower marginal utility slope.

Representing an economic loss with 'e' allows for the utility function to be represented by U = ln(w-e). Letting 'c' represent the economic compensation then allows the utility after the economic loss and subsequent economic compensation to be represented by U = ln(w-e+c) where c represents the economic compensation. Therefore, when ln(w) = ln(w-e+c), the individual has reacquired the original utility through economic compensation. This occurs when e = c, that is to say when the economic compensation is equal to the economic loss.

A noneconomic loss that lowers the utility function by the same amount as the economic loss above without changing the slope can be viewed as the utility function U = ln(w) – ln{w / (w-e)}. After the compensation the utility function would be U = ln(w + c) – ln{w / (w - e)}.

$$\ln(w + c) - \ln\{w / (w - e)\} = \ln(w) \rightarrow$$

$$\ln[(w + c) / \{w / (w - e)\}] = \ln(w) \rightarrow$$

$$(w + c) * (w - e) / w = w \rightarrow$$

$$c = w^2 / (w-e) - w$$

To reacquire the original utility the compensation (c) must equal $w^2/(w-e) - w$.

The third possibility is that the utility is lowered and the slope flatter. The results here are obviously going to be determined by how much the slope is changed. One way

to represent the change in slope, although not the only way, is to view a noneconomic loss as dividing the utility by a value greater than one. Therefore, the same utility after the noneconomic loss can be represented by $U = \ln(w) \div \{\ln(w)/\ln(w-e)\}$. Because economic compensation is effectively being added to wealth the utility after factoring in the compensation would then be $U = \ln(w + c) \div \{\ln(w)/\ln(w-e)\}$. The original utility is reacquired when the compensation (c) is equal to $e^{\{\ln(w)2/\ln(w-e)\}} - w$.

A numerical example helps with interpretation of the above theory. Lets assume an individual starts with wealth of $100,000 they will have a utility of approximately 11.51. [$U = \ln(100,000)$] They experience either an economic or noneconomic loss of $30,000 and their utility drops to ln(100,000 - 30,000), approximately 11.16. In the case of an economic loss, the person compensated $30,000 to achieve their original utility. [$U = \ln(70,000+30,000)$] Now looking at a noneconomic loss that lowers the utility function without changing the slope so that the marginal utility is the same as with a $30,000 economic loss can be represented in an equation by [$U = \ln(100,000) - \ln(100,000/70,000)$]. The person must be compensated approximately $42,857.14 to reach the utility that they had before the noneconomic loss. The third possibility is that the utility is lowered and the slope becomes less steep. The results here are obviously going to be determined by how much the slope is changed. One way to represent the change in slope, although not the only way, is to view a noneconomic loss, as dividing the utility by a value greater than one. Therefore, the same utility after the noneconomic loss can be represented by [$U = \ln(100,000) \div \{\ln(100,000/\ln(70,000)\}$]. In this scenario

it takes approximately $44,495.50 for an individual to achieve their utility level before the noneconomic loss.

Of course the utility functions above were just examples of how the utility function might look and might change, but it shows how a risk adverse utility function is affected differently by different types of losses. Noneconomic losses, ceteris paribas, require more compensation to reacquire the original utility than an economic loss and that a noneconomic loss that lowers the slope requires even more compensation.

THE ESTIMATION OF MEDICAL MALPRACTICE AND HEALTH:

The foundation of the estimation of medical malpractice amount awarded will be based off a previous prior empirical analysis. Health of a population, per capita income, state attitude towards tort lawsuits, education, physician specialty, age of population, health expenditures, and a northeast regional dummy were all variables that theory stated would affect the malpractice amount awarded. The proxy for health used is age-adjusted death rate from 1996 to 1998. The results found that age-adjusted death rate had a positive contribution towards the medical malpractice amount award and was statistically significant at the one percent confidence level. Per capita income was found to have both a linear term and a squared term that were statistically significant at the one percent level. The signs resulted in per capita income having a critical value for a maximum effect on medical malpractice amount awarded. A dummy variable representing state legislation capping non-economic damages at $250,000 was a proxy for state attitude towards tort

lawsuits. This variable had a negative sign and was statistically significant at the five percent level. Education and physician specialty both were put into log form and found to have positive signs with five percent confidence. Age and health expenditures were found not to be statistically significant. The northeast regional dummy was found to have a positive affect on medical malpractice amount awarded at the one percent confidence level.

The first problem encountered when attempting to determine the affect of medical malpractice on health is finding an appropriate measure of health. As stated by the OECD in *Determinants of Health Outcomes in Industrialised Countries: A Pooled, Cross-Country, Time-Series Analysis* (2000), "Most empirical studies rely on mortality rates as a substitute partial indicator because they are objectively measured, relatively precise and readily available."[6] The OECD paper examines the differences in countries across time; however, much of the analysis can be applied to a cross sectional state analysis. The limitation of mortality rates is that older populations will tend to have higher mortality rates. Old age may imply poorer health but this is an inherent feature of the population and is not a reflection of the quality of care. The OECD uses Potential Years of Life Lost (PYLL) per 100,000 population. PYLL is found by first determining what age an average person can "naturally" be expected to live until. Because of the increasing life expectancy in developed countries the OECD decided that 70 years is a reasonable expectation. Every person who dies before the age of 70, then has their age subtracted from 70 and these values are added together. Everyone who dies after the age

[6] p. 55

of 70 is represented by a zero. This number is considered the Potential Years of Life Lost. The OECD runs separate regressions for males and females to capture the differences between the two genders. The independent variables tested were; health expenditures, income, NO_x emissions per capita, share of public health expenditure, share of white-collar workers in total work force, alcohol consumption, tobacco consumption, butter consumption, and sugar consumption. NO_x emissions per capita represent the amount of air pollution. Share of white-collar workers in total work forces is used because nature of work is believed to affect mortality rates. It is also believed to capture the education level because there is a high positive correlation between education and white-collar jobs. As expected health expenditures, income, share of public expenditure, and share of white-collar workers all had negative affects on PYLL, while NO_x emissions, alcohol consumption, tobacco consumption, butter consumption, and sugar consumption all increase PYLL.

CHAPTER IV

THEORETICAL MODEL AND VARIABLES

There exists a national debate on tort reform, and nowhere is this debate more passionate than when referencing medical malpractice. The arguments against medical malpractice center on the concept that large potential awards encourage lawyers to bring forward many lawsuits hoping to "hit the lottery". Supporters of medical malpractice believe that doctors should be held accountable, and that patients deserve to be compensated for the mistakes made. To analyze the effects of medical malpractice lawsuits on health, regression analysis will be utilized.

Although the question is how amount awarded in medical malpractice lawsuits affects health, theory and preliminary econometric analysis suggests that health has already been shown to affect the amount awarded. For this reason there is a danger of simultaneity. The Hausman test will be performed to determine if there is indeed endogeneity. Assuming that there is a simultaneity problem, health of the population and median malpractice payment will be treated as endogenous variables.

Correcting for simultaneity will be achieved by performing two stage least squares analysis of the data. The first stage will be determining a predicted value of medical malpractice amount awarded. This predicted value will then be used in the second stage as an explanatory variable. According to Greene (2003), accurate standard

deviations require using the actual values of medical malpractice amount awarded instead of the predicted values.[7]

The predicted median medical malpractice values will use a regression found in a previous paper as the base. Theory states that economic and noneconomic damages are vital components to predicting median medical malpractice values. In addition there are cultural differences that may play a role in malpractice amounts. It is relatively easy recognizing factors that play a role in economic damages. Variables such as income, age, and cost of medical care should affect the amount of economic damages awarded. Different medical procedures are likely to have different amounts of damage when malpractice occurs. To account for this, the percentage of treatments for each specialty in each state would have been ideal, but unfortunately that information was not available, in its place percentage of physicians specializing in a field is used. Physician specialty will likely affect both economic and noneconomic damages. Noneconomic damages by their very nature are harder to measure. One variable that is likely to affect noneconomic damages are states that impose a $250,000 cap on non-economic damages. This cap on noneconomic damages may not directly affect the median malpractice amount awarded, because all values are under $250,000, but may instead be a proxy for other state legistlation that may affect the amount awarded, it also may capture the attitude of states towards tort lawsuits. Individuals with more education may be viewed to contributing more to society. The amount of education could also affect how the population of the state views medical malpractice. Characteristics of The United States are neither homogenous nor necessarily randomly distributed. It is because of this dual property that regions are included. In particular, culture in the United States varies by region. In the

[7] p. 400

case of endogeneity the variable age adjusted death rate will be replaced with the variables in the health regression analysis sans medical malpractice amount awarded.

The health regression will use age adjusted death rate instead of the Potential Years of Life Lost (PYLL) per 100,000 population with a base year 70 as was used in the OECD research. This is because of the somewhat arbitrary nature of picking 70 as the base age. It also does not factor in the people who die after the age 70 and hence loses a large segment of the population. The dependent variables for health will be similar; health expenditures, income, NOx emissions, and share of public expenditure in total health expenditure will be used just as in the OECD research. Instead of tobacco consumption, packs of cigarettes sold per month per adult will be used. It is reasonable to expect purchases of cigarettes to correspond closely with consumption. Education will be used instead of share of white-collar workers in total work force. Butter and sugar consumption will be replaced with percentage of the population at health risk due to obesity as measured by body mass index. Although the body mass index may not always be an accurate measure of obesity, it is the only variable available to measure food consumption. All of the above variables are directly related to existing theory and have been found in the past to be important. Median malpractice payments will be included in order to test how it affects the health of a population. This is the main variable of interest.

CHAPTER V

DATA AND METHODOLOGY

The data in this thesis unless stated elsewhere is state level data for the year 1998. The nonlinear variables are used because preliminary empirical analysis demonstrated a non linear relationship for some of the regressors.

Centers for Disease Control and Prevention (CDC) provides the age-adjusted death rate in *Health, United States, 2002*. The age-adjusted death rate is calculated for the year grouping, 1996-1998. Age-adjusted death rates are used instead of actual death rates because diseases occur at different rates in different age groups. By normalizing the death rate across ages it becomes possible to more accurately compare relative health of state populations. "Adjustment is accomplished by first multiplying the age-specific rates of disease by age-specific weights".[8] The age specific weights are found by examining the proportion of the US population within each age group to die. These age specific death weights, based on the US population, are then applied to each state to find what the death rate of the specific state is likely to be if they had an age distribution matching the United States as a whole, **AGEADJUS**.

United States Environmental Protection Agency records NOx emissions. Area emissions, **NOXAREAP,** instead of point emissions are used. There are both positives

[8] New York's Department of Health website on age adjusted death rate

and drawbacks to using this approach. Area emissions are estimated based on fuel used, miles driven, etc. This is produced on the county level then summed up to produce state aggregates. Point source is the accumulation of facilities that are easily identified and measured. Area emissions are more comprehensive in nature, but are merely estimates. Point source emissions are exact values, but miss many small sources of pollution. This thesis will use area source emissions to capture more sources recognizing that if pollution is harmful to health, then it is irrelevant where the pollution comes from and under the belief that the estimates produced are a more accurate picture of overall pollution than point source values. The emissions are measured in short tons (2000 pounds).

The percentage of population that is obese is estimated by the Centers for Disease Control and Prevention (CDC) using data from *1998 National Health Interview Survey*. Body Mass Index (BMI) is used to determine obesity. BMI is found by taking weight/(height)^2, where weight is measured in kilograms and height is measured in meters. A value greater than or equal to 30 qualifies as obese. As described in the *Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 1995* body fat may be a better indicator of obesity but, "because body fat cannot be readily measured, weight appears to be the most appropriate surrogate".[9] **OBESITY** and **OBESITSQ** will represent obesity and the squared term.

Packs of cigarettes sold per adult per month were obtained from The Tobacco Institute. The data is collected bimonthly; the months are then averaged to provide a two month average. For the purpose of this paper these bimonthly average was then taken

[9] As reported under "Discussion of Proposed Changes"

and multiplied by two and accumulated for the year. This value was then logged, **LNPACKSP.** One of the bimonthly data groups is 1989 December/January; which consists of Dec, 1989 and January 1990. It is not believed that this will create much of a disturbance in the data, because smoking has a cumulative effect on health. It is a history of smoking that is relevant, not the amount of smoking in the given year. Furthermore, the data compiled from wholesale warehouse removal records where what actually should be captured is consumption. However, sales data is more accurate, easier to capture, and dependent on consumption which out weighs the drawbacks.

Share of public expenditure in total health expenditure was obtained from *1998-1999 State Health Care Expenditure Report* that is co-published by the Milbank Memorial Fund, the National Association of State Budget Officers, and the Reforming States Group. Share of public expenditure typically means the share spent by the state in relation to the total amount spent by individuals and the state combined. However due to lack of data availability a different definition will have to be used. Instead state expenditures will be examined. The report separates spending according to broad categories; "Medicaid, the State Children's Health Insurance Program (SCHIP), state employees' health benefits, corrections, higher education, insurance and access expansion, public health-related expenditures, state facility-based services, and community-based services." The share was found by taking total public health related expenditures divided by total state health care expenditures for the fiscal year 1998, **SHAREPUB**. Public health related expenditures includes, "direct personal health expenditures for specific program areas but does not include subsistence, personal care,

or general public health expenditures" as defined by the report. Examples of programs that would be included in public health related expenditures are local health clinics, licensing boards and regulatory oversight, childhood immunization, health grants, AIDS testing, hearing aid assistance, breast and cervical cancer screening, tuberculosis programs, emergency health services, and education programs.

Median payment amount for medical malpractice tort lawsuits was obtained from *National Practitioner Data Bank 1998 Annual Report*. The median payment amount, in several states, is less than the median amount received by claimants because some states have "State compensation funds, and other similar funds". The NPDB obtains their information from insurance companies and self-insured entities (but not self-insured individuals) that are required to report whenever they make a payment of any amount that benefits a physician, **MEDIANPA**.

Per capita income is from *Bureau of Economic Analysis*. Per capita personal income is found by first summing "wage and salary disbursements, supplements to wages and salaries, proprietors' income with inventory valuation and capital consumption adjustments, rental income of persons with capital consumption adjustment, personal dividend income, personal interest income, and personal current transfer receipts, less contributions for government social insurance", then dividing by the resident population of the state as determined by the Census Bureau's annual midyear population estimates, **PERCAPIT** and the squared term **PERCAPSQ**.

Tort reform is a very diverse group of regulations and therefore it is difficult to precisely categorize states. The category used in this paper, noneconomic damage cap of

$250,000, was taken from a Report to Congressional Requesters created by United States General Accounting Office called *MEDICAL MALPRACTICE: Implications of Rising Premiums on Access to Health Care.* States that have enacted the noneconomic damage cap as of 1995 will be given a dummy value for the variable **NONECON2**.

The age data was acquired from *Population Estimates for the U.S., Regions, and States by Selected Age Groups and Sex* from the U.S. Census Bureau. The estimate is produced by the Population Estimates Program (PEP). Every year the estimates are updated. Population changes throughout the year; estimate given is for July 1. In order to provide the best estimate possible; births, deaths, Federal tax returns, medicare enrollment, and immigration are used to update decennial census base counts. Percentage of the population from ages 18 to 64, **AGE18TO6**, is found by summing smaller population percentages together.

Education was retrieved from the report, *Educational Attainment in the United States: March 1998* from the Bureau of the Census. The report was created from data originating in March 1998 Current Population Survey (CPS). The 90 percent confidence interval for each state varies between 5.6 and 1.8 percentage points. The percentage of population with a bachelor degree or more of education logged, **LNPERPOP**.

The information on number of physicians was collected from *Physician Characteristics and Distribution in the U.S.* which is created by the American Medical Association. (Note: the year 1994 was used for this data because of availability. It is unlikely that the percentages changed much from 1994 and 1998.) Specifically, the

percentage of physicians specializing in anesthesiology is found then logged, **LNANPERC**.

Health expenditure per capita was obtained from *HRSA State Health Workforce Profiles*. The data was taken from the 1998 reports however; the estimate is for 1994, **HEALTHEX**.

Finally, the states comprising of the northeastern dummy was chosen to correspond with the grouping used by the Census Bureau, **NEREGION**. Preliminary empirical analysis showed that the northeastern region was the only region that varied significantly form the rest of the country.

How medical malpractice affects health; is the primary question. Specifically, now median medical malpractice amount awarded affects the age-adjusted death rate. To capture this information the desired regression is of the form:

<u>Model 1</u>: (1) $AGEADJUS = \beta_{21} + \beta_{22}MEDIANPA + \beta_{23}LNPERPOP + \beta_{24}HEALTHEX + \beta_{25}SHAREPUB + \beta_{26}OBESITY + \beta_{27}OBESITSQ + \beta_{28}\ NOXAREAP + \beta_{29}LNPACKSP + U_2$

However, because there exists a significant risk of simultaneity, further models are also needed. A regression of median medical malpractice amount awarded must also be determined. The initial form of this model is determined to be:

<u>Model 2</u>: (2) $MEDIANPA = \beta_{11} + \gamma_{11}AGEADJUS + \beta_{12}PERCAPIT + \beta_{13}PERCAPSQ + \beta_{14}NONECON2 + \beta_{15}LNPERPOP + \beta_{16}LNANPERC + \beta_{17}AGE18TO6 + \beta_{18}HEALTHEX + \beta_{19}NEREGION + U_1$

However; this model must also be modified because of the potential simultaneity. Substituting the explanatory variables of model one for **AGEADJUS** in model two results in the first stage of the two-stage least squares model results in the reduced form:

Model 3: (3) $MEDIANPA = \beta_{11} + \beta_{12}PERCAPIT + \beta_{13}PERCAPSQ + \beta_{14}NONECON2 + \beta_{15}LNPERPOP + \beta_{16}LNANPERC + \beta_{17}AGE18TO6 + \beta_{18}HEALTHEX + \beta_{19}NEREGION + B_{110}SHAREPUB + \beta_{111}OBESITY + \beta_{112}OBESITSQ + \beta_{113}NOXAREAP + \beta_{114}LNPACKSP + U_1$

The predicted value of **MEDIANPA** is kept as **MEDIPHAT** and used in Model 1. This results in the second stage of the two-stage least squares model.

Model 4: (4) $AGEADJUS = \beta_{21} + \beta_{22}MEDIPHAT + \beta_{23}LNPERPOP + \beta_{24}HEALTHEX + \beta_{25}SHAREPUB + \beta_{26}OBESITY + \beta_{27}OBESITSQ + \beta_{28}\ NOXAREAP + \beta_{29}LNPACKSP + U_2$

The variables employed are summarized in the following table:

Table 1

Variables description

AGEADJUS	Age Adjusted Death Rate
MEDIANPA	Median medical malpractice payment
MEDIPHAT	Predicted median medical malpractice payment
PERCAPIT	Per capita income
PERCAPSQ	Per capita income squared
NONECON2	Dummy: $250,000 cap on noneconomic damages
LNPERPOP	log of percentage of population with a Bachelors degree or more of Education
LNANPERC	log of percentage of physicians specializing in anesthesiology
AGE18TO6	Percentage of population between 18 and 64
HEALTHEX	Health expenditures per capita
NEREGION	Dummy: North East geographical region
SHAREPUB	Percentage of public expenditure as part of total health expenditure
OBESITY	Percentage of the population at health risk due to obesity as measured by body mass index
OBESITSQ	Percentage of the population at health risk due to obesity as measured by body mass index squared
NOXAREAP	NOx area emissions per kilometer
LNPACKSP	Packs of cigarettes sold per adult per month logged

CHAPTER VI

RESULTS

This chapter focuses on the results of the equations *(3)* and *(4)*. The model estimates were tested for simultaneity, misspecification errors, heteroskedasticity and multicolinearity. The results are then posted and analyzed for statistical and economic significance.

All regressions are comprised of 50 observations; one for each state. Performing a Hausman test[10] on the relationship between **AGEADJUS** and **MEDIANPA** resulted in a p-value of .0174. This result illustrates that there is simultaneity between the two variables at the 95% confidence level. Therefore; it becomes necessary to perform a two stage analysis instead of a direct regression of equation *(1)*. Two stage least squares will start with equation *(3)* and substitute the explanatory variables of equation *(1)* (sans **MEDIANPA**) in for **AGEADJUS**.

Although the second stage results are the primary interest, it is vital to have a solid foundation built on the first stage. With this in mind the results are posted below in Table 2. This first stage obtains the predicted median medical malpractice amount awarded from its reduced form estimates. There are 36 degrees of freedom in the regression of equation *(3)*. Of particular interest is the R^2, since the predicted values are

[10] Kennedy (1998) p. 151

going to be used in the second stage. The R^2 of the first stage is .536; meaning, 53.6% of the variation is explained by this model.

Table 2

OSL regression – Equation *(3)*

Variable	Coefficient	Standard Error	t-value	P-value
Constant	-609719.275	363599.350	-1.677	0.102
PERCAPIT **	32.025	13.804	2.320	0.026
PERCAPSQ **	-0.001	0.000	-2.506	0.017
NONECON2**	-40581.894	18078.910	-2.245	0.031
LNPERPOP	52378.544	38429.983	1.363	0.181
LNANPERC*	67083.822	24627.934	2.724	0.010
AGE18TO6	279.117	3247.639	0.086	0.932
HEALTHEX	10.573	16.087	0.657	0.515
NEREGION *	47005.299	14216.982	3.306	0.002
SHAREPUB	8690.938	216929.840	0.040	0.968
OBESITY	-27248.440	120830.170	-0.226	0.823
OBESITSQ	3197.352	11162.159	0.286	0.776
NOXAREAP	2178.829	1804.987	1.207	0.235
LNPACKSP	7790.204	16267.110	0.479	0.635

* Significant at the 1% level
** Significant at the 5% level
*** Significant at the 10% level

The explanatory coefficients are valuable only for confirmation that the regression is reasonable. All of the statistically significant coefficients have signs and magnitudes that correspond with preexisting expectations.

Having obtained the predicted median medical malpractice amount from the above regression it is possible to substitute in those values and run the second stage, equation *(4)*. An initial Box Cox test was run to ensure that this regression would not more appropriately be modeled by a double log regression. The l* value of .70, being below the 5% critical value of 3.84, suggests that the two forms are observationally

equivalent. Since the two forms are observationally equivalent the linear model will be used for ease of interpretation. The results are posted below in Table 3.

Table 3

OSL regression – Equation *(4)*

Variable	Coefficient	Standard Error	t-value	P-value
Constant *	1365.333	345.863	3.948	0.000
MEDIPHAT	-0.0001	0.0002	-0.574	0.569
LNPERPOP ***	-53.011	35.774	-1.482	0.146
HEALTHEX **	-0.041	0.016	-2.523	0.016
SHAREPUB *	5.220	2.297	2.273	0.028
OBESITY *	-375.458	125.340	-2.996	0.005
OBESITSQ *	37.957	11.527	3.293	0.002
NOXAREAP *	4.282	1.750	2.447	0.019
LNPACKSP *	65.592	18.265	3.591	0.001

* Significant at the 1% level
** Significant at the 5% level
*** Significant at the 10% level

The R^2 for this regression is .704 suggesting 70.4% of the variance is explained by the model. The Hausman test shows that there is simultaneity between median medical malpractice payment and health. In order to ensure there is not Group I specification error[11] a Ramsey RESET test is performed. The RESET value was .79 which is below the 10% critical value of approximately 2.84. By being below the critical value it suggests that the model contains no omitted variables, has the correct functional form and has no simultaneity.

[11] Ramsey, pp. 350-71

It is important to check for heteroscedasticity in order to ensure that the results obtained are efficient and confidence intervals can be trusted. This can be tested with the Breusch-Pagan test. It resulted in a value 8.522, while the 10% critical value is 13.36. Therefore, the null hypothesis of homoscedasticity is not rejected. It is possible that heteroscedasticity occurs in some specific variables and is not captured by the more general Breusch-Pagan test. The Breusch-Pagan test is only asymptotically valid. Running the Goldfeld-Quandt test on LNPERPOP results in a value of 7.12, this is above the 5% critical value of 3.44. Therefore, heteroscedasticity is confirmed and it should be corrected. Obtaining White standard errors will provide OLS estimates for heteroscedasticity. Table 4, below, contains the results with White standard errors

Table 4

OLS regression correction for heterscedasticity – Equation *(4)*

Variable	Coefficient	Standard Error	t-value	P-value
Constant *	1476.292	283.115	5.214	0.000
MEDIPHAT	0.0001	0.000	-0.910	0.368
LNPERPOP ***	-52.779	29.887	-1.766	0.085
HEALTHEX **	-0.040	0.017	-2.398	0.021
SHAREPUB *	5.427	1.884	2.880	0.006
OBESITY *	-374.706	117.413	-3.191	0.003
OBESITSQ *	37.902	11.115	3.410	0.002
NOXAREAP *	4.285	1.371	3.125	0.003
LNPACKSP *	65.679	13.917	4.719	0.000

* Significant at the 1% level
** Significant at the 5% level
*** Significant at the 10% level

There is no perfect multicollinearity. Examining the correlation matrix of the explanatory variables,[12] indicates the only near perfect multicollinearity is between **OBESITY** and its squared term. This suggests that there is not a harmful relationship between any two of the variables. In order to check for more complicated relationships auxiliary regressions were run. All results, other than **OBESITY** and **OBESITSQ**, had an R^2 below .7. The sum of squared errors was low for some of the variables, which may indicate collinearity.[13] This indicates that although the results are BLUE (best linear unbiased and efficient) they may not be robust.

The log of the percentage of population with a Bachelors degree, **LNPERPOP**, or more is statistically significant at the 10% level. The negative sign is expected; indicating that the more educated the population the lower the age adjusted death rate. This result matches the OECD's paper result for share of white-collar workers in total work force. This translates roughly into a one percent increase in percentage of population with a bachelors or more decreasing age adjusted death rate by .53%.

Health expenditures per capita, **HEALTHEX**, is statistically significant at the 5% level. The sign on this variable also corresponds to the OECD's research. At the margin, for the range of data in this study,[14] every dollar spent reduces the death rate by approximately .04. Although the coefficient is small the difference between minimum and maximum health expenditures is 1803 corresponding with a change of over 72.

[12] Appendix: Table 5 Correlation Matrix
[13] There is little variation in LNPERPOP, SHAREPUB, and OBESITY
[14] Range of data characteristics can be found in Appendix: Table 6 Descriptive Statistics.

Percentage of public expenditure as part of whole health care expenditure, **SHAREPUB**, is statistically significant at the 1% level. This has a different sign then the study done by OECD in large part because of the different definition of "share of public health expenditure". The positive sign suggests that state spending on these programs is not as beneficial as other programs. A one percent increase in **SHAREPUB** results in a 5.43 increase in age adjusted death rate.

Percentage of the population at health risk due to obesity as measured by body mass index, **OBESITY**, and its squared component, **OBESITSQ**, are both statistically significant at the 1% level. A squared term was added because it is possible that obesity affects health in differently depending on the amount of obesity. In fact this is the case; initially obesity is slightly beneficial to health, then after about 5% of the population becomes classified as obese it has an increasingly negative effect on age adjusted death rate. Part of this initial benefit to health may be in part attributed to drawbacks in the Body Mass Index.

NOx area emissions per kilometer, **NOXAREAP**, is statistically significant at the 1% level. It also has the expected positive sign, signifying an increase in pollution corresponds with a decrease in health. Although it is statistically significant and the expected sign, it has a relatively small impact on age adjusted death rate. Because moderately few deaths are directly attributed to pollution each year and it is reasonable to assume pollution is a contributing factor in small number of cases, having a small coefficient is very reasonable. In fact a large coefficient here would be hard to explain.

Packs of cigarettes sold per adult per month logged, **LNPACKSP**, is statistically significant at the 1% level. According to the results smoking has a negative impact on health. A 1% increase in the number of cigarettes corresponds with a .657% increase in the age adjusted death rate.

Because most of the coefficients have signs and magnitudes that make sense it lends credence to the model as a whole. With this information it makes sense to look at the effect of predicted median medical malpractice amounts awarded on health, **MEDIPHAT**. Unfortunately, this variable is not statistically significant. The sign is negative, suggesting that medical malpractice improves health; however this can not be trusted. There is an 81.6% chance that the value is less than 0. Furthermore, even if the coefficient could be trusted, it would correspond with a $10,000 increase in **MEDIPHAT** resulting in only a 1.29 decrease in age adjusted death rate. From this regression it can not be determined if the medical malpractice amounts awarded are beneficial or harmful to the health of a population. Therefore; it is worth looking at a confidence region in order to examine the range of potential impact. The 95% confidence region on a $10,000 increase in **MEDIPHAT** is 1.57 and -4.15. Because often the legislation is specifically looking to restrict medical malpractice lawsuits it is also appropriate to look at a one tale test. There is a 5% chance that a $10,000 medical malpractice increase leads to a decrease of age adjusted health by more than 1.09. It can not be said that laws curbing medical malpractice definitely have a positive or negative impact on health. However; from the data presented it can be stated that laws designed to restrict medical malpractice amount awarded are more likely to hurt the health of a population than it is to increase

health. Because of medical malpractice amount awarded has an uncertain but likely affect of improving health politicians should be cautious before enacting tort reform laws.

CHAPTER VII

CONCLUSION

Good health, or lack of bad health, is a treasured commodity. Every activity can be negatively affected by poor health. Hence, a small change in health can result in a large change in utility. Furthermore; because a decline in health is a nonpecuniary loss, it requires a relatively large monetary award to off set the decline. Medical malpractice lawsuits are one way to add monetary incentive for doctors to avoid mistakes. If all that occurred were fewer mistakes then medical malpractice lawsuits would unconditionally improve health of a population. However, it is possible that physicians have so much motivation to reduce mistakes that they become too cautions. Defensive medicine is when physicians perform more tests, much more expensive tests with little benefit, and in general is more concerned with protecting themselves from potential lawsuits than caring for patients. While this may be effective in reducing lawsuits it is often not economically efficient. As a result medical care is more expensive, which leads to a smaller amount of medical care being provided. Furthermore, medical malpractice lawsuits are blamed for a lack of availability of certain services. It is for these justifications that politicians develop laws to curb medical malpractice lawsuits.

The question then is, "Are the benefits or drawbacks more influential on health?" Once this question can be answered it is possible to apply the findings to suggest the

course of action that will most benefit the health of a population. It is necessary to first determine the proper analysis to run on the data. In this case, because of the simultaneity nature between medical malpractice and health it is necessary to run two stage least square regression.

After running the two stage least square regression and correcting for heteroscedasticity all of the variables other than median medical malpractice amount awarded are statistically significant at least at the 10% level. Furthermore, all the signs and magnitude correspond with previous research except for percentage of public expenditure as part of whole health care expenditure, which may be accounted for by differences in the United States health care system in comparison to the rest of the worlds'. In addition, the model passes the Ramsey RESET test and shows little multicollinearity. All of this supports the validity of the regression. The sign on **MEDIPHAT** is negative, suggesting that large medical malpractice lawsuits may benefit the health of a population. However, the variable of interest is not statistically significant and therefore the negative coefficient cannot be trusted. It can be said that it is more likely that medical malpractice improves the health of a population than hurt it.[15]

The results of the regression do not support laws designed to limit medical malpractice lawsuits, but it cannot say definitively that the laws are harmful to health. With this information the best advice for policy makers is to tread carefully.

Future research in this area should concentrate on changes that might result in a statistically significant coefficient for median medical malpractice amounts awarded.

[15] Likelihood of 63.2% using a two tailed test and 81.9% using a one tail test

This maybe accomplished in a number of ways including; better modeling the first stage that finds the predicted values, collecting data from multiple years and running regressions on the paneled data, or examining a single state across multiple years. A point of interest for further research may be further investigating share of public health expenditure; how it relates to health of a population, how it compares to other state spending, and which programs included in public health expenditure are the most effective. This line of research has the potential to be a valuable policy tool.

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APPENDIX

Table 5
Correlation Matrix

	MEDIPHAT	LNPERPOP	HEALTHEX	SHAREPUB	OBESITY	OBESITSQ	NOXAREAP	LNPACKSP
MEDIPHAT	1	0.243	0.376	-0.217	0.073	0.066	0.521	0.223
LNPERPOP	0.243	1	0.359	0.088	-0.450	-0.463	0.400	-0.346
HEALTHEX	0.376	0.359	1	-0.005	0.032	0.044	0.542	-0.093
SHAREPUB	-0.217	0.088	-0.005	1	-0.109	-0.106	0.045	-0.356
OBESITY	0.073	-0.450	0.032	-0.109	1	0.998	-0.113	0.236
OBESITSQ	0.066	-0.463	0.044	-0.106	0.998	1	-0.115	0.232
NOXAREAP	0.521	0.400	0.542	0.045	-0.113	-0.115	1	0.029
LNPACKSP	0.223	-0.346	-0.093	-0.356	0.236	0.232	0.029	1

Table 6

Descriptive Statistics

Variable	Mean	Standard Deviation	Min	Max	Cases
MEDIPHAT	80632.660	25292.006	35189.917	139496.133	50
LNPERPOP	3.152	0.182	2.785	3.526	50
HEALTHEX	2937.760	374.585	2255.000	4058.000	50
SHAREPUB	0.054	0.022	0.010	0.111	50
OBESITY	5.624	0.618	4.000	6.700	50
OBESITSQ	32.004	6.798	16.000	44.890	50
NOXAREAP	3.276	3.558	0.035	17.399	50
LNPACKSP	2.285	0.303	1.305	2.955	50