The Impact of Malpractice Risk on the Use of Obstetrics Procedures

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Abstract

Recent malpractice premium hikes and President Bush's federal tort reform proposal have focused attention on medical liability costs. One frequent justification for tort reform proposals is the potential impact of liability on defensive medicine. There is however, scant and conflicting evidence on whether malpractice risk alters physician practices. In this paper, I examine whether malpractice risk alters the procedure choices of obstetricians, who face one of the highest rates of malpractice lawsuits and pay much larger malpractice premiums than most other medical specialties. The primary data set for this analysis is the Natality Detail File, which is a census of all births in the United States. By focusing on obstetricians, I can observe the impact of malpractice risk on the use of procedures such as cesarean sections, vaginal births after cesareans, prenatal care visits, the use of diagnostic tests such as ultrasound and amniocentesis, and the use of various equipment and techniques during the delivery such as fetal monitoring, forceps and vacuum extraction. Malpractice risk is measured in two ways: (1) the number of OB/GYN claims per birth in each state over the last three years, and (2) the amount of OB/GYN claims paid per birth in each state over the last three years, using the National Practitioner Data Bank. Because the measured malpractice risk may signal something unobserved about physician quality or practice style, I use malpractice claims against non-OB/GYNs as an instrument for OB/GYN claims. I find that cesarean section rates and most other measures of physician behavior are not sensitive to medical malpractice risk.

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1. Introduction

When a patient is injured due to the medical malpractice of a physician, the injured party can sue the physician for monetary compensation under negligent tort.[1] Compensation is typically paid for any loss of earnings capacity, pain and suffering, and reasonable medical expenses. Most physicians buy malpractice insurance to insure themselves against the payout of malpractice cases.

In the U.S., malpractice insurance premiums increased rapidly in the 1970's and 1980's and again in the early part of this decade. These recent hikes have led the American Medical Association to declare a 'malpractice premium crisis' in 20 states, including Florida, Pennsylvania and New York.[2] Nationwide, malpractice insurance premiums increased 15 percent between 2000 and 2002.[3] During the same time period, specialists in some areas experienced premium increases of more than 100 percent.[4]

Concerns about rising malpractice premiums have caught the attention of lawmakers at the federal and state level. Beginning in 2003, Congress considered federal tort law reform proposals four times, but each time the bills failed.[5] A fifth tort reform bill (H.R.5) has passed through the House, and is currently awaiting discussion in the Senate.[6] Most tort reform proposals include such restrictions as limits on non-economic jury damage awards, limits on attorney fees, and statutes of limitations in all medical malpractice lawsuits. Similar reforms have been passed in a number of states (Dewey, 2005).

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[1] Torts are civil wrongs recognized by law as grounds for a lawsuit. Among three general categories (intentional torts, strict liability torts, negligent torts) medical malpractice falls into the negligent category.
[2] http://www.ama-assn.org/ama/noindex/category/11871.html
[3] Based on the author's calculation using Medical Liability Monitor annual premium survey. No weights were used.
[4] Malpractice premiums increased 115 percent for OB/GYNs in Oregon and 110 percent for general surgeons in Mississippi.
[5] Tort law is state law. (http://www.law.cornell.edu/topics/torts.html).
[6] H.R.5 passed the House in July 2005. The bill includes a $250,000 cap on non-economic damages.

One premise behind these reform bills is that the current tort system encourages an excessive amount of litigation, placing doctors at an increased risk of being sued for malpractice. Reform sponsors also argue that greater malpractice risk adversely affects the delivery of health care in two ways. First, an increase in risk may discourage doctors from treating people with certain conditions or from conducting risky (but potentially beneficial) procedures. The 2003 American College of Obstetricians and Gynecologists (ACOG) survey reported that 14 percent of respondents stopped practicing obstetrics as a result of the risk of litigation. This type of response to malpractice risk may be leading to some serious restrictions in access to necessary healthcare. Second, healthcare utilization may increase as doctors alter their practice patterns. To avoid a lawsuit or increase the chance of winning a malpractice suit, a doctor may perform procedures that have little or no medical benefit to the patients, but that protect him from possible future litigation. This type of behavior is typically referred to as defensive medicine (Kessler and McClellan, 1996).

Opponents of reform bills believe that limiting compensation for the injured can be unfair to the people who have already suffered significantly from medical malpractice. Reform critics are also often concerned that the deterrent effects of tort law would be weakened as a result.[7] It is thus ultimately an empirical question whether doctors respond to changes in malpractice risk by altering their practice patterns.

Given the potential importance of tort reform and the 'malpractice crisis', there is surprisingly little empirical evidence regarding the impact of malpractice risk on health care delivery. Kessler and McClellan (1996) found some evidence of defensive medicine in their analysis of heart attack patients covered by Medicare. But they focus primarily on health care

[7] The two purposes of tort law are monetary compensation for the injured and the deterrence of same negligence by physicians in the future.

expenditures and thus do not shed light on the mechanisms through which this effect operates. While informative, most other studies have important limitations including insufficient variation due to a short time span, possible omitted variable bias, or an inappropriate measure of malpractice risk.

First of all, we need to know whether doctors have an incentive to change their behavior as a result of malpractice risk. Most physicians are fully insured against the financial costs of malpractice such as damages and legal defense expenses.[8] In addition, medical malpractice insurance typically does not have a mechanism such as deductibles, or experience rating, either of which would give the physician a direct financial incentive to respond to increase in risk.[9] Litigation may, however, reduce current earnings due to the loss of practice time, or future earnings due to the loss of reputation. Additionally, there may be substantial legal expenses and emotional stress associated with a lawsuit.[10] Therefore, doctors have two strong incentives: not to be involved in malpractice litigations even with malpractice insurance due to the hassle of involvement and not to pay large payout in the lawsuit since his/her reputation might depend on the size of the payout.[11]

One practice area that is thought to be particularly affected by high malpractice risk is obstetrics and gynecology (OB/GYN).[12] Between 1994 and 2003, twenty four percent of OB/GYN doctors in the state of Massachusetts either made settlement payments themselves or

[8] Of all OB/GYNs surveyed, 94.4 percent reported being covered by medical malpractice liability insurance (2003 ACOG survey). The most common insurance policies limit coverage to $1 million per case or $3 million per year. Only 1.6 percent of claims in my data paid more than $1 million.

[9] Most insurance premiums are experience rated. For example, someone with an auto accident history will pay a higher auto insurance premium compared to a similar person without an accident.

[10] Sometimes doctors hire their own attorneys.

[11] Grant and McInnes (2004) found that patient volume decreased after the large payout claims. I cannot differentiate these two incentives empirically.

[12] Based on Medical Liability Monitor, an OB/GYN practicing in New York City in 2003 paid 5.3 times more for a malpractice insurance premium than an internist, and 1.6 times more than a general surgeon.

had payments made from their insurance carriers. This is substantially higher than most other specialties. For example, 15 percent of general surgeons and only 4 percent of internal medicine specialists had such payments (The Board of Registration in Medicine, Massachusetts, 2004). The ACOG found that 76.3 percent of OB/GYNs experienced at least one lawsuit during their career in a 2003 survey.

OB/GYNs are often cited as a specialty that is particularly impacted by defensive medicine. In particular, it is often suggested that malpractice concerns encourage doctors to perform more cesarean sections (c-sections) than are medically needed. There are a number of avenues through which malpractice fears can alter the decision to deliver the baby by c-section. Some have suggested that plaintiffs can more easily argue doctors' negligence when they fail to perform a timely procedure. Subsequently, the decision to not act, e.g., to not deliver the baby by c-section, leaves a doctor vulnerable to a lawsuit when complications arise.

The birth of a neurologically-impaired infant is the most prevalent reason for a lawsuit in the OB/GYN specialty. Impairment can occur before or during deliveries as a result of fetal distress by a constricted umbilical cord, hemorrhage behind the placenta or intrauterine infection after prolonged rupture of the membranes (ACOG survey, 2003). In deliveries involving a birth injury, doctors are more likely to be suspected as negligent when the baby is delivered vaginally due to the limited control of progress compared to cesarean section (Sachs, 1989). Basset *et al.* (2000) mentioned that understanding current defensive medicine during hospital birth requires, first and foremost, understanding the process whereby physicians have come to act as what is here termed "fetal champions". Therefore, defensive medicine is centered on concerns regarding the condition of the fetus. In case of vaginal delivery, the doctor should prove that cesarean section would not have made any difference and should convince people that everything has been done

(Mavroforou *et al*., 2005). Cyr (2006) notes that many OB/GYNs follow a "When in doubt, cut it out" philosophy which encourages c-sections whenever the doctor has any concerns that a vaginal delivery may threaten the health of an infant.

The 'failure to deliver by c-section' complaint is frequently listed as a reason for a malpractice claim. In a retrospective review of physician malpractice claim records in large New Jersey malpractice insurer, underperformance of cesarean section was cited 10 times more often as a reason for a malpractice suit than failure to delivery the baby vaginally, 31 % vs 3%, respectively (Kravitz *et al*. 1991) In a review of charts from about a quarter million deliveries that were subject to litigation from a single insurer over the 1990-2000 period, Greenberg *et al*. (2006) note that in many cases, early cesarean delivery would have saved money. Among the 91 lawsuits (incidence 4.4 per 10,000) 63 cases could have saved money with planned cesarean and only 5 cases could have save money by delivering vaginally rather than by cesarean. Greenberg *et al*. (2006) also projected that the number of law suits would decrease by 53 percent, and legal costs would decrease by 72.7 percent, if physicians performed universal cesarean sections.

The active role of the physician during c-sections may also help reduce the probability of litigation conditional on a poor outcome. For example, a doctor does not want to be exposed to a situation in which he/she is absent from the hospital during the patient's labor. Vaginal delivery will increase the chance of this occuring due to longer labor times. Compared to a vaginal delivery, doctors play a more active role in deliveries by cesarean section.

Others have argued that the rapid increase of the U.S. c-section rate in the 1980's relative to England (which showed a similar c-section rate to the U.S. in the 1970's) is attributable to the difference in legal environments. Inter state differences in legal environments are also a potential explanation for the more than a 10 percentage point difference in c-section rates between some states within the U.S.[13]

The evidence above establishes that c-sections tend to reduce the chance of an adverse event in some situations, and failure to perform c-sections in some situation is a frequent reason for litigation. However, there is at best limited data linking fear of malpractice with changes in physician style. Several studies have found that cesarean section rate is positively related with increased malpractice risk. (Localio *et al*. 1993, Dubay *et al*. 1999 Tussing and Wojtowycz 1997) Both Localio *et al*.(1993) and Dubay *et al*.(1999) used malpractice premium as the measure of risk. Many researches pointed out that medical insurance premiums are closely related to insurance market competition which means that it is not really reflecting medical malpractice risk (A report by the Americans for Insurance Reform 2002, Grant and McInnes, 2004) Tussing and Wojtowycz (1997) constructed malpractice risk as the cumulative number of obstetric malpractice suits in a county from 1975 to 1986. This malpractice risk measure is constructed to be increasing over time which can generate a spurious relationship if the dependent variable has an increasing trend. These studies are also subject to possible omitted variable bias.

In my empirical analysis, I measure the malpractice risk that doctors face using the National Practitioner Data Bank. This data set is a national universe of malpractice claim resolved either by settlement or jury verdicts for the 15 year period from 1990 to 2005. This long time period allows me to exploit the considerable variation both between states and within a state over time in malpractice risk at the extensive (number of cases) and intensive (awards per case) margins. I calculate malpractice risk in two ways: as either the number of OB/GYN claims per

[13] In 2003, the c-section rate in Florida was 30.8 percent compared to 19.2 percent in Utah based on National Vital Statistics Report, Vol. 54, No. 2, 2005.

1,000 births in each state over the last three years, or the amount of OB/GYN claims paid per birth in $1,000s in each state over the last three years.[14]

The malpractice risk data are then combined with the Natality detail data set which is a census of all live births in the U.S. Detailed information in the data is used to construct a series of treatment measures that have been suspected to be influenced by the malpractice risk OB/GYN doctors face. The large sample size allows me to examine subsamples that may be particularly susceptible to changes in practice style. For example, a doctor's response to higher malpractice risk might vary by patient characteristics such as history of a previous c-section, complications of labor (breech presentation, gestational diabetes, multiple births), or socioeconomic background of the mother. I therefore examine whether malpractice risk alters procedure choice overall and also for these particular at-risk subgroups.

One challenge for reliable identification is that malpractice risk as defined above may be correlated with other factors related to the treatment decision, such as unobserved patient characteristics, physician quality or practice style. For example, if doctors respond to malpractice risk by performing more c-sections, this may decrease the malpractice risk because a c-section lowers the probability of a lawsuit compared to vaginal delivery (reverse causality). In other words, the probability of a lawsuit is not only a function of the legal environment but also a function of procedure choices and other factors as well. To address this issue, I use an instrumental variables (IV) identification strategy that will capture only the malpractice risk generated by a state's legal environment. In particular, I use the malpractice risk in non-OB/GYN specialties as an instrument for the OB/GYN risk measure.

[14] I use three years for the following two reasons. The average litigation process takes three to four years and malpractice risk is a noisy measure, because the incidence rate is low.

My findings demonstrate that cesarean section rates are not responsive to medical malpractice risk. Additionally, utilization of health care, measured by the number of prenatal visits during pregnancy, is also insignificantly related to malpractice risk. I also find that malpractice risk has no statistical or qualitatively important impact on the use of other procedures such as ultrasound, fetal monitoring, forceps, or vacuum. The one exception is amniocentesis, a diagnostic procedure that is used substantially more as malpractice risk increases. Taken together, the findings suggest that malpractice risk does not have a significant effect on the behavior of obstetricians.

The paper is arranged as follows. Section 2 reviews the previous literature on malpractice risk and its impact on physician behavior. Section 3 describes the data used, the empirical analysis and my identification strategy. Section 4 reports the empirical results and Section 5 discusses the implications of my findings.

2. Literature Review

Although there has been considerable discussion about the impact of defensive medicine on medical care costs, there is relatively little evidence that malpractice risk alters medical decisions. There are two types of studies that have attempted to measure the behavioral changes induced by malpractice risk. The first type uses surveys of providers while the second type examines the reduced-form relationship between healthcare expenditures and outcomes and the changes in the malpractice environment.

A number of different surveys have tried to assess how physicians responded to tort litigation. For example, the Office of Technology Assessment (OTA) conducted a survey of three specialties including OB/GYN. The survey described a hypothetical scenario and asked doctors which diagnostic procedures they would prescribe. Doctors were also asked to choose the major reason for the procedure choices with one possible response being malpractice risk. They found that, by their definition, 8 percent of diagnostic procedures preformed are medically unnecessary.

Kessler and McClellan (1998) combined survey data from the American Medical Association Socioeconomic Monitoring System (AMA SMS) with tort reform data and found that doctors who faced higher malpractice risk increased both record keeping and the number of diagnostic tests preformed. However, it is well known that surveys are potentially subject to response bias (Grant and McInnes, 2004). This problem may be particularly acute in direct physician surveys, because physicians may be tempted to exaggerate the impact of malpractice pressure in order to buttress the political argument in favor of liability reform (Klingman *et al*., 1996). Indeed, physicians estimated the probability of defending against a malpractice claim in any one year to be about three times higher than the actual probability of such a claim arising (Lawthers *et al*., 1992; Weiler *et al*., 1993).

Using state tort reforms that cap an injured patient's award as an exogenous change in malpractice risk, Kessler and McClellan (1996) showed that total expenditure declined for Medicare patients with acute myocardial infarction and ischemic heart disease in states that experienced tort reform. However, these states did not experience any statistically significant change in outcomes such as mortality. The authors were unable to tell which procedures were 'defensive' in nature (i.e., whether fewer diagnostic tests were prescribed or less aggressive treatment lowered costs).

Using data from the 1990-1992 periods, Dubay *et al*. (1999) analyzed a within-group model correlating changes in c-section rates and malpractice premiums. They found that higher OB/GYN malpractice premiums had a statistically insignificant impact on the rate of cesarean delivery among all births. In contrast, they found that among unmarried and less than high school graduate mothers, a group suspected to have a higher rate of being a malpractice plaintiff, malpractice premiums had a statistically significant positive impact on the c-section rates. While informative, there are two potential limitations of this study. First, given the short sample period, there is some question as to whether there was sufficient within-panel variation in premiums to successfully identify their model. Second, it is not clear whether higher premiums indicate an elevated malpractice risk for the doctor. While premiums do depend both on claim frequency and claim severity, they also depend on other market factors, such as interest rates and market competitiveness, and hence may measure the malpractice environment poorly (Grant and McInnes, 2004). Indeed, Black *et al*. (2005) did not find a strong correlation between paid claims and malpractice insurance premiums. A report by the Americans for Insurance Reform (2002) pointed out that medical insurance premiums are closely related to insurance market competition but not paid claims.[15]

Baicker and Chandra (2004) utilized state-level data on premiums and closed claims to examine the impact of malpractice risk on healthcare delivery. They examined average malpractice risk from 1992 to 1994 and compared it with the average malpractice risk from 1999 to 2002. They found no statistically significant positive relationship between c-section rates and OB/GYN claims. Their estimates are also possibly subject to an omitted variable bias problem that I mentioned earlier.

Using hospital discharge data and closed claims data from Florida over the 1992-1995 period, Grant and McInnes (2004) estimated the changes in doctor-specific c-section rates after physicians experienced malpractice litigation. They found that after litigation, physicians had a

[15] http://www.insurance-reform.org/StableLosses.pdf

one-percentage point higher risk-adjusted c-section rate. If the malpractice risk that a doctor faces depends on not only his/her experience of being sued, but also on the malpractice claim history for the same specialty in their region, Grant and McInnes' estimates are a lower bound estimate of the true impact of malpractice risk. Taken together, the previous literature provides conflicting evidence regarding the impact of increased malpractice risk on physician behavior.

3. Empirical Methodology

3.1 Data

There are two major sources of data for this study: the National Practitioner Data Bank Public Use Data File and the Natality Detail File. The National Practitioner Data Bank (NPDB) is an extensive collection of data on malpractice payouts, including pre-trial settlements throughout the nation. If a malpractice insurance carrier pays on behalf of a practitioner, the carrier is required by the Healthcare Quality Improvement Act of 1986 to report data about the claim to the NPDB within 30 days of the payout. This public-use data file is updated at the end of each quarter.[16] For this project, I use the NPDB Public Use Data File containing reports received from September 1, 1990 through March 31, 2005. I measure malpractice risk from 1992 to 1998 after dropping cases which took more than 6 years to resolve from injury occurrence, for consistency throughout the data period, because some claims take several years to resolve.

The NPDB Public Use Data File records the year of injury and the year of report and has information about the size of the payment, related services (obstetric-related, medication-related, etc), practitioner's work state and practitioner's field of license (physician, pharmacist, dentist, etc.)

[16] http://www.npdb-hipdb.com/publicdata.html

for each case.[17] To maintain confidentiality of the data, payment amounts are recorded into ranges only.[18] Payments are also top coded at $105 million, but no payments exceeded this amount during my data period.

Even though the NPDB is the most extensive data set about closed malpractice cases, it has several limitations. First, it only lists closed cases with a positive payout. In the introduction, I argued that there may be both psychic and economic costs to defending against a malpractice claim. As a result, not counting cases with zero payout may be understating the malpractice risk faced by physicians. Second, tort cases are decided locally (e.g., juries are selected at the county level) so there may be variation within a state in malpractice risk. However, the NPDB does not identify sub-state geographic information, so I cannot measure any within-state variation in malpractice risk. Third, the NPDB cannot link multiple defendants for a single case together when they are reported separately. Fourth, hospitals are not included as providers. Therefore, hospitals that are the sole defendants in a case are not included in the data set. Likewise, closed cases in the NPDB that included both hospitals and physicians as defendants only list the physician defendants. Despite these limitations, it is the most accurate source of information for the entire U.S. over a long period regarding physician malpractice risk.

The Natality Detail File is a census of all live births in the U.S. and includes almost 24 million births for the 7 years (1992-1998) in which I have measures of malpractice risk. This data has demographic information about the mother (age, education, marital status, race, and ethnicity), the father (age, race, and ethnicity), characteristics of the pregnancy (parity, plurality, gestation,

[17] For each claim, there are six potential dates of interest: date of injury, date of opening a legal case, date of reporting to insurance company by doctors, date of a case closing (by jury verdict or settlement), payment date, and date of report (when the NPDB received the record). Only year of injury and year of report are available in the data.

[18] For example, $10,000 increments are used for actual payments between $100,001 and $1 million, Payments between $1 million and $10 million are coded as the midpoint of $100,000 increments. Between $10 million and $20 million, a $1 million increment is used.

maternal weight gain, smoking and drinking during pregnancy, prenatal visits, breech presentation, high blood pressure and gestational diabetes), and method of delivery. The data also include information about who attended the delivery, such as a midwife or a medical doctor.[19]

3.2 Measuring Malpractice Risk

I measure malpractice risk using closed claims information in the NPDB Public Use Data File. Theoretical models of the tort liability system typically assume that agents respond to both the probability and the size of liability awards. Subsequently, I construct two measures of malpractice risk: one that measures the number of cases (frequency) and another that measures the size of liability payments (severity) per birth.

As I mentioned above, there is tremendous heterogeneity across medical specialties in the lifetime risk of being sued for malpractice. This is not surprising. OB/GYNs care for different types of patients and perform a very different service than dermatologists or psychiatrists. As a result, each specialty should have different underlying levels of malpractice risk. For this reason, I measure malpractice risk within each specialty.

The malpractice risk faced by doctors is also assumed to vary by state and year, based on several factors. Each state has a different tort environment (tort law and precedent by jury, etc.). Practice patterns also vary substantially for different regions (Nicholson and Epstein, 2003). For the most part, insurance companies also set malpractice premiums according to a physicians' specialty, type of practice, and geographical location (Quinn 1998).[20] For example, OB/GYNs

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[19] In this analysis, I only use births delivered by medical doctors since midwives do not have the same procedure choices, such as cesarean section delivery, nor do they face the same malpractice risk. Less than 8 percent of births were delivered by midwives in the seven years worth of data I use.

[20] Type of practice means a hospital- or office-based practice. Insurance companies define their own geographical categories. Only nine big states such as New York, and California, have geographic variation in prices within a state.

practicing in New York have very different malpractice risk from OB/GYNs practicing in Wyoming because of different legal environments as well as different practice patterns.

The NPDB identifies both the year of injury and the year of report so the malpractice risk can be measured using one of these years as the frame of reference. The key question to address is this: if doctors are altering their practice style based on malpractice risk, are they altering their behavior after alleged malpractice occurs (date of injury) or when a malpractice suit is paid out and then reported to the NPDB (date of report)? Research on this question by Grant and McInnes (2004) suggests that behavior changes are associated with the incident that led to the malpractice claim, not with the closure of the claim. Subsequently, I look for evidence that OB/GYN's practice defensive medicine after an injury occurs. Unfortunately, injury claims only make it into the NPDB once a case has been closed, which many times can be years after the injury. Therefore, I must define a consistent window after which an injury occurs when cases will be reported in the NPDB.

Figure 1 reports the distribution of years when the case is reported to the NPDB for injuries that occurred in 1993 for all medical malpractice cases.[21] The mean year of report is 1997.3, the median is 1997 (the fourth year after the injury), and the mode is 1996 (the third year after the injury). Note, however, that a small fraction of cases are being reported ten to twelve years after a patient is injured. I find very similar results in Figure 2 in which I graph the distribution of total dollars paid (in real 2002 dollars) for reported cases resulting from injuries in 1993. Most cases are settled within a few years of the actual injury. In Figure 3, I report the

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For example, depending on the insurance carrier, there are three to six geographical regions within California in 2002. The rest of the states tend to have one premium for each specialty. I use state as the geographical level since only state is observed in NPDB.

[21] OB/GYN cases have the same shape of distribution with bigger mean year of 1998, the fifth year after the injury.

cumulative distribution of closed claims for injuries occurring in 1993. Roughly 80 percent of cases are reported within six years of injury.

Although I have Natality data through the early 2000s and the NPDB data are reported through March of 2005, the long lag between injury and the claim report observed above means that I cannot use the latest years of data. If the distribution of paid claims in 2002 is similar to the distribution in 1993, then only about 15 percent of 2002 claims have been reported by March of 2005.[22] In order to have a consistent measure of malpractice risk across all years in the sample, I will use the same window of years after injury for cases to be reported. This will understate the total closed claims from earlier years in the sample, but all years will be treated equally.

The choice of the length of the window that I will use requires tradeoffs. Using a longer window will generate more accurate measurement of risk but will reduce the available years of data that I can use from the Natality detail data. For example, a two-year window would allow me to use data through 2002 and a four year window would allow me to use data through 2000.[23] Unfortunately, as the numbers in Figure 3 illustrate, the shorter the window, the fewer actual reported claims will be included in the malpractice risk index.

I use a window of 6 years after the injury to construct the malpractice risk measure.[24] Cases being reported within the same year that an injury happens are rare.[25] Therefore, I decided to drop cases reported in the same year when the injury occurred, basing this decision on the same logic I used to drop cases reported after 6 years from the injury.[26]

[22] The distribution of lags between injury year and report year is indeed very stable throughout my data period.
[23] Although I have data reported by March 2005 I assume that I have data until 2004 as a complete year.
[24] I cover 81 percent of injuries in terms of frequency based on figure 5 with this window. Figure 6 shows slightly lower coverage which is 76 percent in terms of severity by using a 6 year window.
[25] Only around one percent of cases based on the number of claims or 0.3 percent of cases based on the amount of payout are closed within the same year from the year injury happened.
[26] Results are robust even if I use a 5-year window instead of a 6-year window.

With the text above as a backdrop, we can define malpractice risk in the following manner. The variable C_{sjt} denotes the number of reported cases where the injury occurred in state *s* in year *t*, with the gap between injury and reporting measured in years by *j*. The numbers of births in thousands in state *s* and year *t* are written as B_{st}. These variables can be used to construct the malpractice risk for OB/GYNs in state *s* in year *t* R_{st}^{OB}.

$$(1)\ R_{st}^{OB} = (\sum_{j=1}^{6} C_{sjt}) / B_{st}$$

The number of malpractice injuries in a given year should be proportional to the size of the exposure, so I divide the number of OB/GYN malpractice cases by the number of births in thousands. For another measure of malpractice risk I use the amounts of OB/GYN claims paid after adjusting for inflation using the urban consumer price index for the year of the report in thousands of dollars and then dividing it by the number of births.[27]

It is likely that doctors will consider not only this year's risk but also risk in recent years. To account for this, I will use a three-year moving average to measure the level of risk that doctors face. The choice of a three year moving average is subject to discussion.[28] Considering that the average litigation process takes three to four years, it is reasonable to assume that there is persistence in the malpractice risk from year to year. An additional benefit is that it will give a less noisy measure because the incidence rate is quite low. I denote the moving average of risk in OB/GYN as MAR_{st}^{OB}:

$$(2)\ MAR_{st}^{OB} = (\sum_{k=0}^{2} R_{st-k}^{OB}) / 3$$

[27] The paid year, not reported year, should be used. But paid year is not recorded in the data. Considering the rule that all paid claims should be reported within 30 days after payout reported year is a good proxy.
[28] Results are robust to not using moving average for the risk measure.

To construct the malpractice risk for OB/GYN doctors in 1993, I use obstetric-related cases in which an injury happened in 1993, and the case was reported by 1999. Then the frequency of these included cases is divided by the number of births (in thousands) in 1993. The severity of these cases is measured in thousands of dollars divided by the number of births in 1993. Measured risk for OB/GYN doctors as in equation (1) in 1993, 1992 and 1991 was averaged to get the final measure of risk in equation (2) that OB/GYN doctors face in 1993.[29] I have constructed malpractice risk in this way from 1992 to 1998. I cannot include data for 1999 because the six-year window for injuries occurring in this year is past the date of my last observation. The incorporation of the three-year moving average also forces me to drop the first two years of observations for which I have outcome data (injuries that happened in 1990 or 1991).

Table 1 presents descriptive statistics for the malpractice risk that OB/GYN doctors face. The first column contains the malpractice risk OB/GYNs face for the full sample, "all births", over 1992 - 1998. In the second column I present malpractice risk for non-OB/GYN specialties which will be used as an instrumental variable. The amount of OB/GYN claims paid per birth in $1,000s and the amount of non-OB/GYN per population in $1,000s are presented in 2002 dollars. OB/GYNs face an average probability of a successful malpractice suit of 0.19 percent for every 1,000 deliveries. Based on the severity measure presented in the bottom of Table 1, OB/GYN doctors face an average risk of $73 in payout for each delivery. The numbers in the second column indicate that all of the non-OB/GYN specialties face a lower level of malpractice risk. They face 0.04 percent probability of a positive payout malpractice suit by frequency risk measure for every 1,000 procedures and $8 in 2002 dollars payout for each procedure.

[29] I used 1992, 1991 and 1990 to construct malpractice risk in 1993 with the concern that it might take some time to share the information. My results are robust to these different measures.

3.3 Definition of Outcomes

The extensive data available in the Natality Detail File provide me with a number of outcomes that measure the practice patterns of physicians. The most frequent outcome analyzed is the method of delivery: vaginal or cesarean. There are different costs and benefits of each procedure. Women who delivered a baby by cesarean section can have a higher risk of hemorrhage, blood clots, and bowel obstruction as well as infection because it is a major abdominal surgery. They also have to be hospitalized longer and are more likely to be re-hospitalized subsequently. Women with a vaginal delivery are more likely to experience minor issues like urinary incontinence. However, a baby that is born vaginally is more likely to have a nerve injury (Maternity Center Association, 2004).

The following series of arguments suggest that cesarean section rates are employed as defensive medicine. Most obstetrical malpractice litigation is triggered by injuries to babies such as brain damage.[30] In both animal experimentation and epidemiological studies, it has been shown that total asphyxia in full-term infants leads to brain damage and in many cases to perinatal death (Sachs, 1989).[31] There is a greater chance of asphyxia when the baby is delivered vaginally. When an injury occurs and the baby is delivered vaginally, the plaintiff has a greater ability to allege a failure to perform a timely cesarean section or misinterpretation of the fetal heart rate tracing, or both, resulting in death or brain damage (of the baby) (Sachs, 1989).

There is also some suggestive evidence that c-section rates in the U.S. are responsive to malpractice risk. Cesarean section rates in the US (6 percent) were similar to that of Europe

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[30] The primary allegation of obstetric claims is a neurologically impaired infant (34.3%) and still birth or neonatal death (15.3%) based on the 2003 ACOG survey.

[31] Asphyxia means a condition in which an extreme decrease in the concentration of oxygen in the body accompanied by an increase in the concentration of carbon dioxide leads to loss of consciousness or death (*The American Heritage Dictionary of the English Language, Fourth Edition)*. Perinatal means the five months before and one month after birth.

(England 5 percent, Hungary 6 percent) in the early 1970s. The U.S. rate increased to 20 percent between 1981 and 1983 while rates in England increased to only 10 percent (Watson *et al*., 1987). Some have suggested that one possible explanation for the divergence in c-section rates between the two countries is the difference in legal environments. The U.S. legal system, often described as litigious, could be driving the difference in c-section growth rates compared with other countries.[32]

The Natality Detail File includes information on prenatal care, including the number of doctor's office visits during the pregnancy and the use of diagnostic procedures such as ultrasound and amniocentesis. The data also indicates if equipment or technology such as fetal monitoring, forceps, or vacuum extraction were used during labor. Ultrasound is a commonly-used diagnostic procedure that allows the provider to observe the development of a fetus. Amniocentesis is a procedure performed during the early stages of pregnancy to detect genetic or chromosomal disorders using sample fluid from the mother's womb. Fetal monitoring is typically performed during delivery to check the baby's heart rate. Steel forceps or soft cup vacuum extractors can be used to assist vaginal delivery when it does not progress spontaneously or when the baby must be delivered immediately due to either fetal distress or maternal fatigue.

Prenatal care visits are recorded as integer counts and values range from 0 to 49. All other outcomes are recorded as dummy variables where usage of the procedure, test, or device is given a value of 1.

3.4 Subsamples

[32] Litigious America, Newsweek International, July 30, 2001

I use a census of births in the U.S. from 1992-1998. This is referred to as the "All Births" sample in the Tables in the text. Some patients are more likely to be more affected by a physician's change in practice style stemming from an increase in malpractice risk. I divide the data into six different subsamples that might be more or less susceptible to practice pattern changes based on the mother's history of previous delivery, complications during birth, or socio-economic status.

The Centers for Disease Control and Prevention (CDC), and King and Lahiri (1994) claim that a c-section may represent defensive medicine for some patients and that this would be especially true for patients with a previous c-section.[33] Within the medical profession, there is substantial disagreement on the costs and benefits of vaginal deliveries after c-sections (VBACs) and as a result, a consensus guideline for treatment has not yet been reached. The old concept could be summarized by the phrase, "Once cesarean forever cesarean." The supporting idea was that a woman who has a scar in her uterus as a result of a previous cesarean section might have a higher probability of experiencing a rupture in a future labor. Repeated cesarean would then reduce the chance of separation of the uterus. However, c-section carries its own risks, such as blood clots, bowel obstruction, or infection, since it is a major abdominal surgery.

Due to the lack of consensus in the medical profession about the desirability of VBACs, and partly due to movements by such groups as the CDC and ACOG to lower the repeated cesarean section rate, VBAC rates have fluctuated significantly over time. Almost 19 percent of patients who had a previous c-section delivered their baby vaginally in 1989, but this rate increased sharply to 28.3 percent by 1996, and then declined rapidly to 20.6 percent by 2000. A

[33] The Centers for Disease Control and Prevention have targeted that by the year 2010 the U.S. cesarean delivery rate for women giving birth for the first time should decrease to 15 percent from the 1998 baseline rate of 18 percent (U.S. Public health service, 1991). They specifically wanted to increase vaginal birth after cesarean rates to 37 percent from 28 percent (the 1998 rate) by the year 2010.

high risk of trying vaginal labor for patients with a previous c-section, and a lack of consensus in the medical profession, may lead obstetricians to respond to the malpractice risk that they face when they practice for this subgroup of patients. This group is referred to as the "Previous cesarean section" sample in the tables and in the text.[34]

There are specific high-risk medical conditions such as breech presentation for pregnancy. Breech presentation means that a baby is in buttocks or feet-first position instead of a head first position. For some breech presentations, vaginal delivery can pose serious health risks for both the mother and the baby (Sachs, 1989). Other conditions that produce more frequent use of c-sections include gestational diabetes, multiple births and high blood pressure. These potentially high-risk patients could lead doctors to choose more defensive procedure choices. People also have expressed concern that care for these high-risk pregnancies could be impacted by heightened professional liability risk.

Low socio-economic status patients are another subgroup of women that researchers believe are differentially affected by physicians' practice changes (Dubay *et al*., 1999). Some state governments have experienced reduced obstetrician participation in Medicaid.[35] One possible reason is the common notion that low-income patients are more litigious with physicians even though the data does not confirm this.[36] These low socio-economic status patients also have lower incomes and a higher probabilities of adverse outcomes which might lead to litigation. They have limited access to health care including prenatal care due to medical insurance status or time constraints. Therefore, obstetricians might choose more defensive procedures or perform

[34] Several studies found that Patients who tried VBAC but failed in the end have higher risks of uterine disruption and infectious morbidity compared with repeat cesarean delivery (Hibbard et al., 2001, Landon et al., 2004, Scott et al., 1998, Mozurkewich and Hutton, 2000).
[35] For example, providers participating in Medicaid maternity care declined by 4.3 percent in 1986 compared to the year before in Washington state.
[36] General Accounting Office (GAO), U.S. Congress. 1987. Medical Malpractice: Characteristics of Claims Closed in 1984. GAO/HRD-87-55

more diagnostic tests when they care for this subgroup. In this paper, I classify the low socio-economic status group as those with less than or equal to a high school degree.[37]

In Table 2, I present descriptive statistics for a variety of outcomes on the full set of patients in the first column. The "previous cesarean section" sample is presented in the second column. In the third column, I present the subgroup that has not had a previous c-section at the time of delivery, which is the residual population from the second column. I present the subsamples of patients with complications in columns 4, 5 and 6: breech presentation, gestational diabetes and multiple births. In the far right column I present births to mothers with a high school degree or less as the low socio-economic subsample.

Except for prenatal visits, the statistic presented is the percentage of patients receiving the given procedure. Given the large sample size, standard deviations for these discrete outcomes are approximately equal to $[\overline{X}(1-\overline{X})]^{0.5}$ where $\overline{X}$ is the sample mean. The primary outcome in the analysis is the choice between c-section and vaginal delivery, and this outcome is given in the first row. C-section rates vary considerably across subsamples as expected. Only sixteen percent of pregnancies are delivered by c-section among the patients who had not had a previous c-section. On the other hand, eighty-six percent of pregnancies are delivered by c-section in the case of breech presentation. The number of prenatal visits could measure the mother's access to health care. Interestingly, the number of prenatal visits does not vary much across subsamples. The use of diagnostic tests (ultrasound and amniocentesis) during pregnancy, and the use of equipment or technology like fetal monitoring, forceps and vacuum extraction during labor are my other outcome variables reported in rows three through seven. Use of ultrasound and amniocentesis are

[37] I also tried the socio-economic classification which was used by Dubay *et al.*: unmarried, less than high school degree or unmarried, high school. Results are robust to different classifications of socio-economic status.

significantly higher for women with complications. Patients with less than or equal to a high school degree have the lowest rates of use of diagnostic tests among all subsamples. Note that since forceps and vacuum are assisting tools for vaginal deliveries, I include only vaginal deliveries in the samples for these rows.

3.5 Econometric Model

The basic question I examine is whether a higher malpractice risk faced by OB/GYNs alters procedure choices. As discussed above, I measure risk (MAR) in two ways: (1) the number of OB/GYN claims per 1,000 births over the last three years in a state, and (2) the amount of OB/GYN claims paid per birth in $1,000s over the last three years in a state. The basic econometric model is a within-group specification, in which I examine within-state changes in the use of procedures over time as malpractice risk changes. This model can be described by the following specification:

$$(3) \quad Y_{ist} = X_{ist}\beta + \lambda MAR_{st}^{OB} + \theta_t + \alpha_s + \nu_{ist}$$

where Y_{ist} measures the procedure choice (e.g., the binary variable equals 1 if the baby was delivered by c-section and equals 0 for vaginal deliveries) for patient *i* in state *s* in year *t*; X_{ist} denotes the mother's observable characteristics which include age, race and education; θ_t is a year fixed effect; α_s is a state fixed effect; and ν is an idiosyncratic error. In all models, I calculate variances allowing for arbitrary form of heteroskedasticity and allowing for arbitrary correlation in errors within a state.

The use of a within-group specification is critical for a variety of reasons. Much of the variation in malpractice risk is due to permanent differences across states. If I regress the state-level malpractice risk on state and year fixed effects, I obtain R-squared values of 0.73 and 0.68 for the frequency risk measure and the severity risk measure, respectively. This is not surprising. Each state has a different tort law system, leading some states to have a more favorable legal climate for plaintiffs than others.

We could capture some of these permanent differences by including a series of descriptive variables that characterize a state's tort law system. However, these variables would imperfectly measure these differences, especially in the case of medical malpractice, since tort law is based on both common and statutory law.

More importantly, I am concerned that the same factors that lead to a different legal environment may also reveal something about the medical environment. For example, suppose a state has lower quality medical services with a higher than average frequency of true medical malpractice. In this case, the medical tort system within a state may evolve reflecting the higher rate of malpractice. The state legal environment may alter the burden of proof for plaintiffs, or payments conditional on judgment may differ as well. To address these unobservable differences between states, I use a within-state model that uses variation over time in malpractice risk and procedure choices to identify the model. Therefore, any difference in practice style or malpractice risk that is permanent across states will be purged from the analysis by adding state fixed effects.

Even if I use a within-group model, malpractice risk may signal something unobserved about physician quality. Suppose that low-ability doctors are more prone to use c-sections so as to minimize the possibility of an emergency situation such as fetal distress or dystocia, common complications of vaginal deliveries. At the same time, low ability doctors are also more likely to be sued, since the quality of their service provided is substandard. If this is the case, then there is a positive correlation between the malpractice risk and error term in (3), biasing upward the coefficient λ.

Omitted variables bias might also be generated by reverse causality. As I mentioned above, deliveries by c-sections are less likely to be sued than vaginal deliveries. If doctors shed risk by performing more c-sections, this may decrease the malpractice risk as I've constructed it. If this is the case, then there is a negative correlation between the malpractice risk and error term in (3), biasing downwards the coefficient λ.

To reduce the possibility of omitted variable bias, I will use an instrumental variable (IV) procedure. A 2SLS model will produce a consistent estimate of λ if I can identify an instrumental variable that alters the OB/GYN malpractice risk but does not directly impact c-section rates. I will use a measure of malpractice risk for all other medical specialties except OB/GYN as an instrument.

As I demonstrate below, it is easy to establish the first criteria, namely, that within-state malpractice risk is correlated across specialties. This instrument captures medical malpractice risk that is specific to each state and year observation that is not based on practice style. Potential plaintiffs consider a number of factors when deciding whether or not they should seek a legal remedy for their injuries. One factor they consider is the legal climate within the state. The state tort laws or recent jury verdicts may encourage or discourage patients from seeking remedies regardless of medical specialty. Subsequently, in any given year, the malpractice risk for OB/GYNs and non-OB/GYNs in a state may be correlated since both risks are governed by the same legal climate.

The other criterion to be a valid instrument is that the instrument must not directly impact the outcome of interest. In other words, OB/GYNs should depend only on their own specialty's risk, not other specialties' risks for their procedure choices. For example, when the number of malpractice claims in cardiology increases due to medical services provided to their patients OB/GYN doctors will not change their procedure choice (e.g., c-section and vaginal delivery) based on increased malpractice risk in cardiology. Each specialty has its own underlying malpractice risk which does not depend on other specialties partly because each specialty, especially OB/GYN, provides unique medical services. Separate malpractice insurance premia by specialty reflects these factors. Therefore, changes in malpractice risk for non-OB/GYNs will not change the procedure choice of OB/GYNs unless it is subsumed in the legal environment.[38]

In summary, the legal environment may be reflected in both OB/GYN and non-OB/GYN malpractice risk. However, it is unlikely that OB/GYNs are responding to the higher risk levels in non-OB/GYN specialties. The higher risk that doctors face in all other specialties except OB/GYN should be subsumed into the OB/GYN risk through the legal environment. Therefore, my assumption that malpractice risk in non-OB/GYN affects OB/GYN procedure choices only through the legal climate seems reasonable.

I measure non-OB/GYN risk exactly the same way as OB/GYN risk with only one exception. I use the number of births as a denominator to calculate risk per case for OB/GYNs, but for non-OB/GYN cases, I use the resident population of the state in the relevant year as the denominator.

4. Results

[38] The worst possible scenario for my instrument is that doctors' abilities in OB/GYN and non-OB/GYN in a state move together over time. However, my instrument will be valid unless doctors in all specialties have the same preference in geography (e.g., one region experience lower ability doctors throughout all specialties) and it looks like doctors are more likely to change preference on specialty based on future income over time since the opening for each specialty is very limited (Bhattacharya, 2005; Hurley, 1991).

4.1 The Impact of Malpractice Risk on the use of Cesarean Section

In Table 3, I report OLS and two-stage-least-square (2SLS) estimates of equation (3) for one outcome variable, cesarean section, for the all births sample. I only report the estimated coefficient on the malpractice variable, as that is the coefficient of primary interest. In the first panel, I present OLS estimates which are potentially biased for the reasons mentioned above. I use two measures of risk: the number of OB/GYN claims per 1,000 births and the amount of OB/GYN claims paid per birth in thousands of dollars. Standard errors appear in parentheses. The negative sign of the coefficients for malpractice risk suggest that fewer cesarean sections are performed when risk increases, which is contrary to the conventional wisdom. However, none of the coefficients are estimated precisely. In addition, the elasticity for the number of OB/GYN claims per 1,000 births reported in square bracket is -0.0062, which is very small. The elasticity for the amount of OB/GYN claims paid per birth in $1,000s is even smaller.

The second panel of Table 3 presents the first stage results for the 2SLS estimates. The coefficient estimates for both non-OB/GYN risk measures are positive and statistically significant at the 1 percent level, meaning that the instrument and OB/GYN malpractice risk are correlated. In the third panel, I report the 2SLS estimates for the malpractice risk measures.[39] The coefficient of risk measured as the number of OB/GYN claims per 1,000 births decreases greatly compared to the OLS estimate. However, not surprisingly, the standard errors increase substantially. As a

[39] Due to the large number of observations I cannot run the regression using each birth as the unit of observation. I collapsed the data into cells based on the covariates which are all discrete (such as age, race, marital status, education, state and year) and use the cell size as a frequency. Unfortunately, there is no STATA procedure that allows calculating clustered standard errors in a 2SLS model with fixed-effects and using frequency weights. Therefore, I run the first stage, get the predicted value and use this predicted value in the second regression. In this case I will not get the correct standard error because the actual malpractice risk is required to calculate the correct 2SLS standard errors. I am able to compare estimates from this procedure with estimates from a 2SLS model for breech presentation since it has only 940,378 observations. I do not need to use frequency weight and STATA provides for 2SLS without using frequency weight. The standard errors differ from each other in the fifth digit after the decimal point. So I am comfortable presenting standard error estimates based on this alternative procedure.

result, the 2SLS estimates are statistically insignificant. For risk measured as the amount of OB/GYN claims paid per birth in $1,000s, the 2SLS estimate is much larger than the OLS estimate. It is positive, which supports the hypothesis that c-sections increase with higher malpractice risk. However, this estimate is also imprecise. Based on the p value of the Hausman test for exogeneity reported at the bottom of Table 3, I cannot reject the null that the OLS estimates are statistically equal to the 2SLS estimates. While the magnitude of the estimates changed substantially, the increased standard error makes it difficult to reject the null hypothesis.

The elasticity calculated from the 2SLS results using the number of OB/GYN claims per 1,000 births or the amount of OB/GYN claims paid per birth in $1,000s are both still very small. If the amount of OB/GYN claims paid per birth in $1,000s increased from the 25th percentile to the 75th percentile (which is a 54 dollar increase in risk per delivery) the rate of cesarean sections would increase by just 0.1 percentage points, which is 0.6 percent of the mean. In other words, it is the case that for every 10,000 babies delivered, 2,278 babies are delivered by c-section. A 129 percent increase in risk will increase the number of babies delivered by c-sections by 14. Even if the true impact of the malpractice risk were at the top end of the 95 percent estimated confidence interval, an increase in the amount of OB/GYN claims paid per birth in $1,000s from the 25th percentile to the 75th percentile would increase the c-section rate by only one percentage point. Therefore, although the estimates are statistically insignificant, we can reject the hypothesis that the impact of malpractice risk on c-section choice is substantial.

In Table 4, I expand my analysis of cesarean sections into the six different subsamples discussed earlier. In the first column, I repeat the all births sample that I presented in Table 3 as a reference. The rest of the columns are classified into three categories: (1) based on pregnancy history of having had a previous c-section (candidates for VBAC in the 2nd column and the rest of sample in the 3rd column), (2) complications of pregnancy (breech presentation, gestational diabetes, and multiple births), and (3) low education (less than or equal to high school graduate) as socio-economic status.

In the first panel, I report OLS estimates. Standard errors that allow for heteroskedasticity and arbitrary covariance in errors within a state are reported in parentheses and the elasticity is reported in square brackets. The coefficients of interest are all negative except for the no previous c-section group in column 3 for both frequency (number of OB/GYN claims / 1,000 births) and severity (amount of OB/GYN claims paid / birth in $1,000s) but statistically insignificant. The first-stage estimates for 2SLS in the second panel are statistically significant at the 1 percent level throughout all of the subsamples. The 2SLS estimates reported in the third panel differ substantially from the OLS estimates. Some of the 2SLS estimates such as all births using amount of OB/GYN claims paid/birth in $1,000s even changed sign from the corresponding OLS estimates but the direction of movement from OLS is not consistent throughout the subsamples. However, all of the coefficients are estimated imprecisely and I cannot reject the null based on the p values of the Hausman test for exogeneity reported in the last panel.

Consider the magnitude of the estimate using the amount of OB/GYN claims paid per birth in $1,000s for less than or equal to high school degree. If the malpractice risk were to increase from the 25th percentile to the 75th percentile the cesarean sections rate would increase by just 0.2 percentage points, which is 0.8 percent of the mean. In other words, babies delivered by c-sections would increase by only 16 from 2,180 for every 10,000 babies born to mothers with less than or equal to a high school degree as a result of a 129 percent increase in risk.

4.2 The Impact of Malpractice Risk on Other Outcomes

In Table 5, I report OLS estimates for various outcomes using the number of OB/GYN claims per 1,000 births as the risk measure. The number of prenatal visits as an outcome is presented in the second row. Higher malpractice risk could limit patients' access to healthcare if some doctors decided to stop practicing OB/GYN as malpractice risks increased. On the other hand, doctors might want to see patients more often to decrease the possibility of litigation. The estimated effect here is positive, which suggests that pregnant women see doctors more often when doctors face higher malpractice risk. For pregnant women who have gestational diabetes, higher malpractice risk produces a statistically significant increase in prenatal visits. In the next two rows, I report results for the ultrasound and amniocentesis outcomes. Some doctors were sued due to failure to detect certain genetic problems in advance which can give parents broader choice.[40] Therefore, doctors might want to perform diagnostic tests to detect any genetic problems more aggressively with increased malpractice risk. Indeed, these estimates suggest that doctors are more likely to use these diagnostic tests with a higher malpractice risk. For mothers who had a c-section previously and for mothers having multiple births, the coefficient on malpractice risk in the amniocentesis equation is estimated with statistical precision. The coefficients on malpractice risk for both subsamples are 0.05 and 0.08, respectively. I find a positive sign in all subgroups for use of vacuum except for the multiple births subgroup. No statistically significant change however is detected.

I next report 2SLS estimates in Table 6 for each subsample, using the number of OB/GYN claims per 1,000 births. The p-value from the exogeneity test is in curly brackets. For the use of

[40] http://www.njatty.com/articles/medmal/cfsm03b.html

amniocentesis, the 2SLS estimates are six times larger than the corresponding OLS estimates and these estimates indicate that amniocentesis rates increase as doctors face higher malpractice risk. I reject the null of exogeneity meaning that the 2SLS estimates are significantly different from their OLS counterparts. Looking at the multiple births sample, the elasticity of amniocentesis for this group is 1.3, which is very large. Increasing the malpractice risk from the 25th percentile to the 75th percentile would increase the rate of amniocentesis by 4.1 percentage points, which is 64.7 percent of the mean. For every 10,000 multiple birth babies, 626 have an amniocentesis test and 405 more babies would have amniocentesis when the risk increases 85 percent. For the rest of the subgroups, the impact of malpractice risk on the use of amniocentesis is somewhat smaller. There is one more statistically significant estimate for the gestational diabetes subsample. Use of vacuum extraction will increase 1.3 percentage points when malpractice risk increases from the 25th percentile to the 75th percentile.

Table 7 presents OLS results for risk measured as the amount of OB/GYN claims paid per birth in $1,000s. Use of amniocentesis is positive throughout all subgroups and statistically significant for the previous cesarean section, gestational diabetes, multiple births and less than or equal to high school degree subgroups. For the previous cesarean section subgroup, malpractice risk has a statistically significant positive impact on the use of amniocentesis, forceps and vacuum extraction.

In Table 8, I report 2SLS results using the amount of OB/GYN claims paid/birth in $1,000s as the risk measure. When the number of prenatal visits is the dependent variable, the coefficient is negative, which suggests there might be some problem with access to health care that changes the sign from OLS estimates. However, all of the estimates are statistically insignificant with relatively small elasticities.

Malpractice risk increases the use of amniocentesis by a statistically significantly amount in all subsamples except breech presentation. For the previous cesarean section subsample, if the malpractice risk increases from the 25th percentile to the 75th percentile the rates of amniocentesis increase by 3 percentage points, which is 54 percent of the mean. For every 10,000 multiple births babies, 536 babies have the amniocentesis test as a baseline. If malpractice risk were to increase by 77 percent, 290 more babies would have the amniocentesis test. For the same subsample, forceps and vacuum extraction usage also would increase by a statistically significant amount, but the value is smaller in magnitude with elasticities of 0.6 and 0.4, respectively.

4.3 Other Measures of Malpractice Risk

There are some other ways to measure malpractice risk. One is to use a different source of closed claims data that has some advantages over the NPDB. The state of Texas collects data on closed malpractice cases within their jurisdictions and this data is publicly available to researchers. Texas is the 2nd largest state measured by population and the 3rd largest in total health care spending (Black *et al*., 2005). The advantages of the Texas data are as follows. The Texas data has county level information as well as the month and year of injury, filing of the suit and payment. The Texas data also has a unique identifier that allows me to combine multiple defendant cases into a single case. It also includes the payment of cases on behalf of hospitals.

I have analyzed the Texas closed claims data collected from 1988 to the present using a within-county model. In this analysis, I found that malpractice risk has no statistically significant impact on procedure choices. I also find an insignificant first stage at the 5 percent level using an instrumental variable constructed in the same way as in this paper. It might be because the judicial area does not completely match with the county or, as we see in the malpractice insurance market, it has a different market area from the county border. In any case, the model does not have a sufficiently large sample size to be successfully identified.

The other possible source of a malpractice risk measure is to use malpractice premiums, which have been used in several previous studies. The Medical Liability Monitor surveys malpractice insurance premiums annually at the state level or, in some cases, at the sub-state level.[41] With this data, I used the log of the average annual premium for OB/GYNs from 1994 to 2002 as a measure of the malpractice risk that OB/GYNs face. I then used the log of premiums for general surgeons as an instrumental variable. The estimates from the first stage of the 2SLS estimates were significant at the 1 percent level, but the 2SLS estimates were insignificant for most outcomes, including c-section rates. As other research has found, my results show very little correlation between premiums and either frequency or severity of malpractice claims. Because of space limitations I do not report results using the Texas closed claims data or the malpractice premiums but they are available upon request.

4.4 Marginal Patient Sample

When OB/GYNs choose the delivery method between a c-section and a vaginal delivery, they consider various medical and physical conditions. Therefore, not all women are equally likely to have a c-section. Some conditions, such as breech presentation, increase the chance of a c-section greatly. When the patient's medical condition makes the choice obvious, malpractice risk is less likely to affect a doctor's behavior. However, for some patients where the method of delivery is not as certain based on observed characteristics, malpractice risk could be a larger

[41] Respondents report the base premium for coverage providing $1 million per claim and $3 million in aggregate for a year, which is considered standard coverage. Survey respondents report premiums for three specialties (internal medicine, general surgery and OB/GYN) and company-specific premiums vary by state-specific sub-markets.

factor in the doctor's decision. For example, a patient with certain conditions might be treated using a c-section by some doctors and using vaginal delivery by others.

In this section, I develop a model that attempts to telescope in on those patients who are most likely to be affected by malpractice risk. I will call this sample “the marginal patient sample” because it excludes patients with the lowest and highest probabilities of having a c-section. To find the marginal patient sample, I regressed medical and physical information on a dummy variable that equals one if a cesarean section was preformed, with state and year fixed effects. The model fits quite well – the R^2 for this regression is 0.17. Next I rank patients by their predicted probability of having a cesarean section by descending order. Patients who fall between the 12.5th percentile and the 37.5th percentile of the descending order of predicted c-section probability are the marginal patient sample considering the roughly 23 percent c-section delivery rate for all births in my data. The marginal patient sample has 5.8 million observations.

Table 9 displays descriptive statistics on the two measures of risk for this marginal patient sample. It is very similar to that of previous subgroups reported in Table 1. In Table 10, the impact of malpractice risk on cesarean section for the marginal patient sample is reported. In the first panel I present estimates from OLS specifications. For both measures of risk I find negative and insignificant estimates with very small elasticities. The first stage of the 2SLS regression is significant as reported in the second panel. 2SLS estimates reported in the third panel are still negative and insignificant. Even if the true impact of the malpractice risk were at the top end of the 95 percent estimated confidence interval, an increase in the number of OB/GYN claims per 1,000 births from the 25th percentile to the 75th percentile would increase c-section rates by only 0.6 percentage points. When I use the amount of OB/GYN claims paid per birth in $1,000s the malpractice risk at the top end of the 95 percent estimated confidence interval would increase c-section rates by 1.6 percentage points, which is small. In the last panel, I report the p-value from an exogeneity test and I cannot reject the null that OLS estimates are equal to the 2SLS estimates.

5. Conclusion

During the past year, President Bush has argued for ‘common-sense’ medical liability reform to protect patients, to stop sky-rocketing costs associated with frivolous lawsuits, to make health care more affordable and accessible for all Americans, and to keep necessary services in communities that need them most.[42] A frequent justification for tort reform is the concern that malpractice risk may encourage doctors to alter their practice style. To date, there is little evidence supporting this point. In this paper, I examined whether a higher risk of malpractice awards alters procedure choice in obstetrics. I focused on the obstetric specialty because it is exposed to one of the highest malpractice risks in medicine and it is often considered to be a specialty in which defensive medicine is particularly prevalent.

In a sample spanning 7 years and containing more than 24 million observations, I find that doctors' procedure choice is insensitive to the risk that they face. I also find that increased malpractice risk has little if any impact on health care access, as measured by the number of prenatal doctor’s office visits. I also find no statistically significant change in other measures of treatment such as ultrasound, forceps, and vacuum as malpractice risk changes. Even though I find some significant increase in the use of amniocentesis when malpractice risk increases, overall I do not find substantial changes in behavior by obstetricians as malpractice risk increases.

There are some limitations of this paper in terms of data. One is that the NPDB data is not complete because it does not cover payouts on behalf of hospitals (Smarr, 1997). It also did not

[42] http://www.whitehouse.gov/news/releases/2005/01/20050105-2.html

include cases that ended without any positive payment. However, the NPDB data is the most extensive existing data set and the results are not different even if I use a state of Texas data set, which has some advantages such as including claims against hospitals.

Another limitation is that there is more than one possible explanation for my findings. For example, there may be no significant principal agent concerns that lead to defensive medicine because doctors only care about the patients' outcomes. The other possibility is that malpractice risk is still too small for doctors to change procedure choices. In addition, the measure of risk that I construct is still only a proxy for malpractice risk even though it is the best one given the available data. Therefore, it might not capture perfectly the risk as it is perceived by physicians. Unfortunately, this paper cannot distinguish between these explanations and thus further research is needed.

In the 1970s and 1980s, many states enacted tort reform in order to control malpractice insurance premiums. However, the issue of malpractice premiums has recently returned as an object of public concern. One of the most important reasons for further reform at the federal level is the potential adverse impact of increasing malpractice premiums on health care delivery through changes in doctors' behavior. Based on my findings, it appears that federal level tort reform will have at most a minimal impact on the way doctors practice medicine.

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Figure 1:

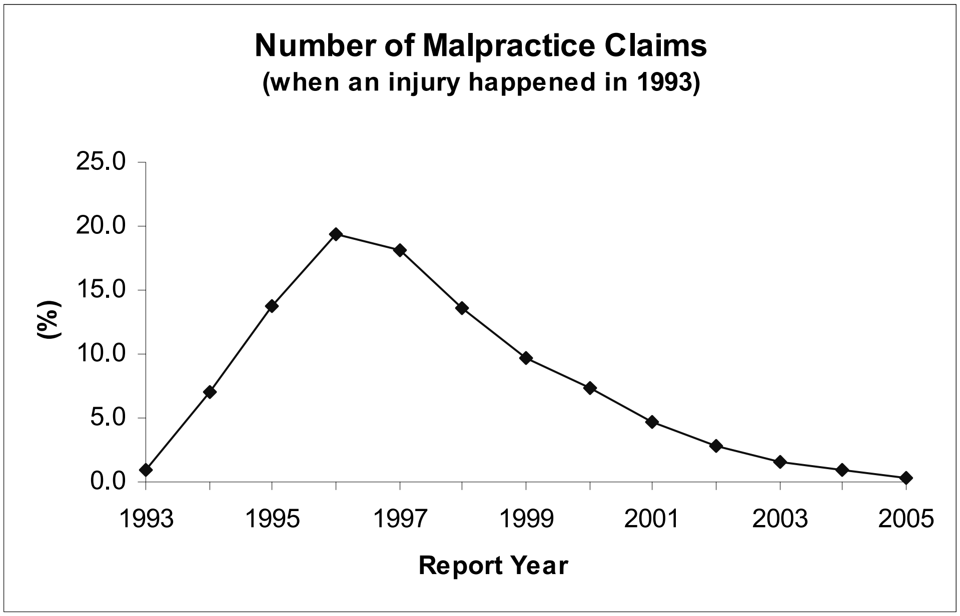

Figure 2:

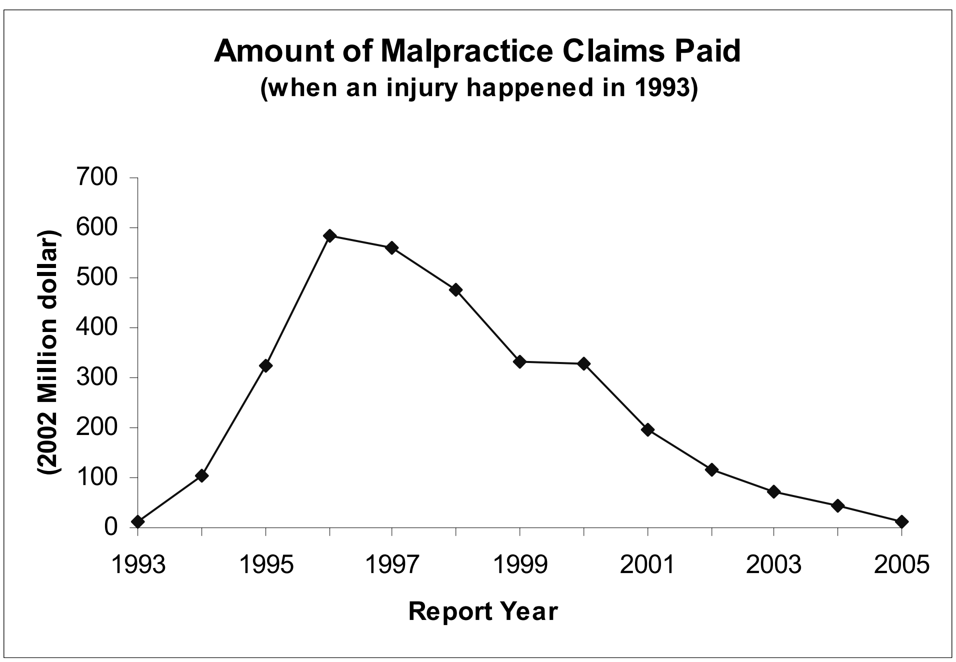

Figure 3:

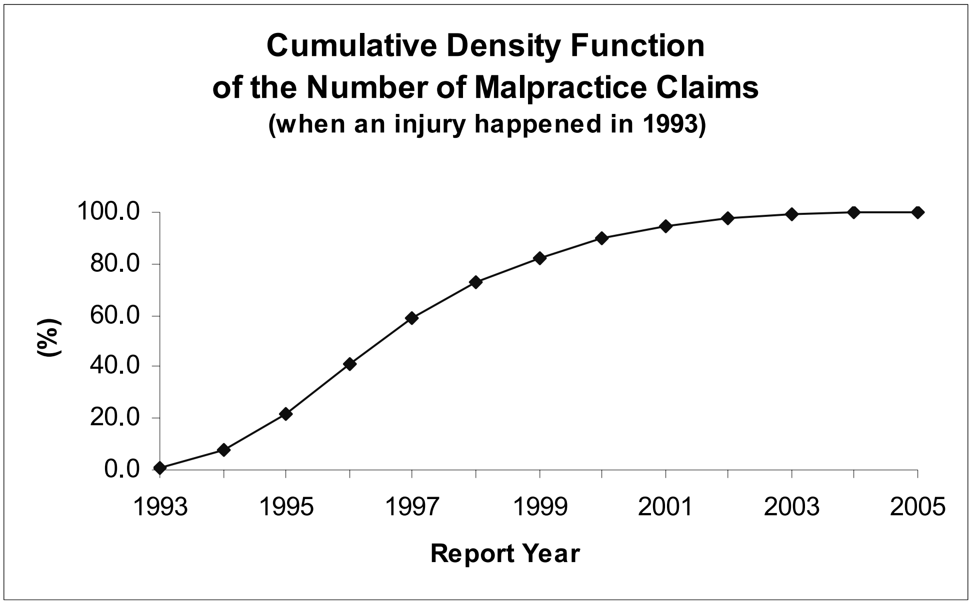

Figure 4:

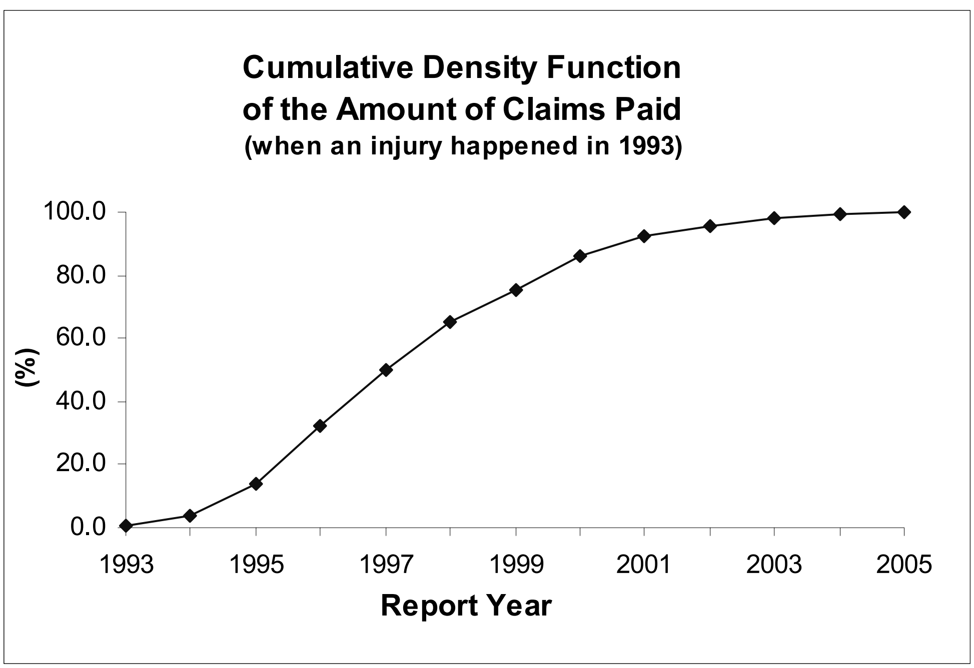

Table 1. Descriptive statistics of measured risks in OB/GYN and non-OB/GYN

	Number of OB/GYN Claims/1000births	Number of non-OB/GYN Claims/1000population
1%	0.0620	0.0105
5%	0.0936	0.0181
25%	0.1357	0.0291
50%	0.1762	0.0394
75%	0.2292	0.0439
95%	0.3136	0.0586
99%	0.4318	0.0645
Mean	0.1874	0.0382

	Amount of OB/GYN Claims Paid/Birth	Amount of non-OB/GYN Claims Paid/Population
	unit: $1,000 in 2002 dollars	
1%	0.0151	0.0030
5%	0.0272	0.0039
25%	0.0408	0.0049
50%	0.0635	0.0072
75%	0.0943	0.0104
95%	0.1591	0.0152
99%	0.2120	0.0186
Mean	0.0733	0.0082

Table 2. Descriptive Statistics of Outcome Variables,
Various Samples

		Subsamples					
		History		Complications			S.E.S
	All births	Previous cesarean section	No previous C-sec.	Breech	Gest. Diabetes	Multiple Birth	≤ HS Degree
C-section Delivery	22.78	75.59	16.09	85.87	37.27	56.44	21.80
Prenatal Visits	11.45 (1.28)	11.59 (1.35)	11.43 (1.29)	11.55 (1.76)	13.05 (1.77)	12.95 (2.54)	10.87 (1.22)
At least one Ultrasound	62.43	67.38	61.80	72.80	70.97	70.63	60.47
Had amnio-centesis	3.22	5.36	2.94	5.38	9.18	6.26	1.90
Had fetal monitoring	81.64	78.00	82.10	81.50	87.08	81.65	80.71
Used Forceps*	4.87	5.78	4.83	11.16	5.98	5.86	4.21
Used Vacuum*	7.75	9.36	7.69	9.02	8.57	9.26	6.93
N	23,639,438	2,657,393	20,982,045	940,378	622,569	644,402	13,108,946

I present standard deviations for continuous variables and these numbers are in parenthesis. All outcomes except prenatal visits are presented by percentage. Prenatal visits recorded the number of visits to doctor's office from 0 to 49. Give our large sample sizes, standard deviations for discrete outcomes are approximately equal to $[\bar{x}(1-\bar{x})]^{0.5}$ where $\bar{x}$ is the sample mean.
* Cesarean section population is dropped since these procedures are applied only for vaginal delivery.

Table 3. Impact of Malpractice Risk on Cesarean Section,
All Births Sample

Risk Measure	All Births
OLS Estimates Dependent variable: Cesarean Section	
Number of OB/GYN Claims /1000births	-0.0076 (0.0181) [-0.0062]
Amount of OB/GYN Claims Paid /Birth in $1,000	-0.0101 (0.0221) [-0.0032]
First Stage Estimates	
Number of non-OB/GYN Claims /1000population	3.97 (0.92)
Amount of non-OB/GYN Claims Paid/Population in $1,000	5.96 (1.76)
2SLS Estimates Dependent variable: Cesarean Section	
Number of OB/GYN Claims /1000births	-0.0412 (0.0727) [-0.0338]
Amount of OB/GYN Claims Paid /Birth in $1,000	0.0262 (0.1108) [0.0084]
Exogeneity Test (P value)	
Number of OB/GYN Claims /1000births	0.609
Amount of OB/GYN Claims Paid /Birth in $1,000	0.724
N	23,639,438

Standard errors in parenthesis are clustered by state. Elasticities are in brackets.
State, year fixed effects are included.
The independent variables for regression are age, race(White, Black, Hispanic and other), marital status(1 if married), and education(less than high school, high school graduate, some university, and university graduate).

Table 4. Impact of Malpractice Risk on Cesarean section, Various Samples

		Subsamples					
		History		Complications			S.E.S
	All births	Previous cesarean section	No previous C-sec.	Breech	Gest. Diabetes	Multiple Birth	≤ HS Degree
	OLS Estimates, Dependent variable: Cesarian Section						
Number of OB/GYN Claims/1000births	-0.0076 (0.0181) [-0.0062]	-0.0391 (0.0640) [-0.0098]	0.0022 (0.0146) [0.0025]	-0.0694 (0.1096) [-0.1528]	-0.0554 (0.0306) [-0.0285]	-0.0197 (0.0420) [-0.0666]	-0.0033 (0.0173) [-0.0027]
Amount of OB/GYN Claims Paid/Birth in $1,000	-0.0101 (0.0221) [-0.0032]	-0.0750 (0.0784) [-0.0073]	0.0127 (0.0182) [0.0057]	-0.1121 (0.1873) [-0.0976]	-0.0749 (0.0504) [-0.0155]	-0.0393 (0.0655) [-0.0532]	-0.0031 (0.0232) [-0.0010]
	First Stage Estimates						
Number of non- OB/GYN Claims/1000population	3.97 (0.92)	3.98 (0.89)	3.97 (0.92)	4.00 (0.99)	3.99 (0.93)	4.02 (0.91)	3.81 (0.86)
Amount of non- OB/GYN Claims Paid/Population in $1,000	5.96 (1.76)	5.82 (1.69)	5.97 (1.77)	5.98 (1.98)	5.81 (1.64)	6.01 (1.69)	5.63 (1.73)
	2SLS Estimates, Dependent variable: Cesarian Section						
Number of OB/GYN Claims/1000births	-0.0412 (0.0727) [-0.0338]	-0.0895 (0.2092) [-0.0225]	-0.0218 (0.0598) [-0.0253]	-0.0398 (0.1808) [-0.0876]	-0.0170 (0.0915) [-0.0087]	-0.1924 (0.1285) [-0.6511]	-0.0338 (0.0737) [-0.0286]
Amount of OB/GYN Claims Paid/Birth in $1,000	0.0262 (0.1108) [0.0084]	-0.3606 (0.4168) [-0.0355]	0.0575 (0.0935) [0.0261]	-0.1971 (0.4329) [-0.1716]	-0.0718 (0.1601) [-0.0149]	-0.0887 (0.1837) [-0.1202]	0.0319 (0.1240) [0.0103]
	Exogeneity Test (P value)						
Number of OB/GYN Claims/1000births	0.609	0.765	0.659	0.847	0.640	0.143	0.648
Amount of OB/GYN Claims Paid/Birth in $1,000	0.724	0.441	0.612	0.812	0.983	0.775	0.763
N	23,639,438	2,657,393	20,982,045	940,378	622,569	644,402	13,108,946

See foot note for Table 3.

Table 5. Impact of Malpractice Risk on Various Outcomes,
Various Samples, Using the Number of OB/GYN Claims per Births as a Measure of Risk

		History		Complications			S.E.S
Outcomes	All births	Previous cesarean section	No previous C-sec.	Breech	Gest. Diabetes	Multiple Birth	≤ HS Degree
	OLS Estimates, Number of OB/GYN Claims/1000births						
C-section delivery	-0.0076 (0.0181) [-0.0062]	-0.0391 (0.0640) [-0.0098]	0.0022 (0.0146) [0.0025]	-0.0694 (0.1096) [-0.1528]	-0.0554 (0.0306) [-0.0285]	-0.0197 (0.0420) [-0.0666]	-0.0033 (0.0173) [-0.0027]
Prenatal visits	0.2561 (0.5023) [0.0041]	0.0714 (0.4850) [0.0011]	0.2834 (0.5070) [0.0046]	0.8846 (0.5198) [0.0144]	1.2485 (0.6100) [0.0183]	0.8578 (0.8005) [0.0126]	0.4176 (0.5517) [0.0070]
At least one ultrasound	0.0106 (0.1026) [0.0031]	0.0570 (0.1174) [0.0160]	0.0053 (0.1017) [0.0016]	0.0533 (0.1099) [0.0138]	0.0600 (0.1066) [0.0162]	0.0738 (0.1363) [0.0199]	0.0132 (0.0880) [0.0040]
Had amnio-centesis	0.0228 (0.0133) [0.1326]	0.0484 (0.0206) [0.1717]	0.0198 (0.0124) [0.1259]	0.0358 (0.0218) [0.1258]	0.0357 (0.0274) [0.0746]	0.0779 (0.0304) [0.2376]	0.0145 (0.0083) [0.1408]
Had fetal monitoring	0.0232 (0.0552) [0.0053]	0.0025 (0.0644) [0.0006]	0.0239 (0.0554) [0.0054]	0.0261 (0.0533) [0.0060]	0.0112 (0.0501) [0.0024]	0.0055 (0.0683) [0.0012]	0.0310 (0.0603) [0.0070]
Used Forceps*	0.0190 (0.0164) [0.0731]	0.0340 (0.0249) [0.1118]	0.0182 (0.0162) [0.0704]	0.0710 (0.0573) [0.1203]	0.0013 (0.0272) [0.0041]	0.0454 (0.0244) [0.1479]	0.0188 (0.0165) [0.0823]
Used Vacuum*	0.0078 (0.0176) [0.0188]	0.0520 (0.0276) [0.1056]	0.0060 (0.0174) [0.0145]	0.0063 (0.0718) [0.0132]	0.0364 (0.0243) [0.0815]	-0.0261 (0.0256) [-0.0538]	0.0070 (0.0185) [0.0186]
N	23,639,438	2,657,393	20,982,045	940,378	622,569	664,402	13,108,946

* Cesarean population was dropped for this dependent variable analysis since this procedure is not used in case of cesarean section
See foot note for Table 3.

Table 6. Impact of Malpractice Risk on Various Outcomes,
Various Samples, Using the Number of OB/GYN Claims per Births as a Measure of Risk

		History		Complications			S.E.S
Outcomes	All births	Previous cesarean section	No previous C-sec.	Breech	Gest. Diabetes	Multiple Birth	≤ HS Degree
		2SLS Estimates, Number of OB/GYN Claims/1000births					
C-section Delivery	-0.0412	-0.0895	-0.0218	-0.0398	-0.0170	-0.1924	-0.0338
	(0.0727)	(0.2092)	(0.0598)	(0.1808)	(0.0915)	(0.1285)	(0.0737)
	[-0.0338]	[-0.0225]	[-0.0253]	[-0.0876]	[-0.0087]	[-0.6511]	[-0.0286]
	{0.609}	{0.765}	{0.659}	{0.847}	{0.640}	{0.143}	{0.648}
Prenatal Visits	0.4450	0.2512	0.4928	0.8028	-1.0668	-1.1059	1.1778
	(2.2200)	(2.1869)	(2.2272)	(2.4892)	(2.6407)	(3.5442)	(2.5133)
	[0.0072]	[0.0041]	[0.0080]	[0.0131]	[-0.0156]	[-0.0163]	[0.0199]
	{0.922}	{0.926}	{0.914}	{0.970}	{0.314}	{0.540}	{0.729}
At least one Ultrasound	-0.1625	0.1951	-0.2059	0.3034	0.3900	0.1524	-0.1427
	(0.2495)	(0.2954)	(0.2480)	(0.3022)	(0.2823)	(0.2828)	(0.2483)
	[-0.0487]	[0.0550]	[-0.0623]	[0.0788]	[0.1054]	[0.0412]	[-0.0435]
	{0.408}	{0.558}	{0.313}	{0.324}	{0.172}	{0.734}	{0.468}
Had amnio-centesis	0.1300	0.2837	0.1103	0.2095	0.3021	0.4134	0.1020
	(0.0500)	(0.0849)	(0.0460)	(0.0575)	(0.0747)	(0.0927)	(0.0328)
	[0.7565]	[1.0067]	[0.7015]	[0.7363]	[0.6315]	[1.2613]	[0.9904]
	{0.020}	{0.003}	{0.032}	{0.002}	{0.000}	{0.000}	{0.004}
Had fetal monitoring	0.1757	0.1487	0.1749	0.3284	0.2023	0.0218	0.2130
	(0.2697)	(0.2885)	(0.2699)	(0.2655)	(0.2962)	(0.3009)	(0.2912)
	[0.0403]	[0.0362]	[0.0398]	[0.0761]	[0.0445]	[0.0051]	[0.0486]
	{0.525}	{0.568}	{0.530}	{0.207}	{0.473}	{0.951}	{0.484}
Used Forceps*	0.0578	0.1561	0.0532	0.4373	0.1424	0.0451	0.0561
	(0.0862)	(0.1231)	(0.0855)	(0.2822)	(0.1135)	(0.0957)	(0.0891)
	[0.2224]	[0.5136]	[0.2059]	[0.7409]	[0.4569]	[0.1469]	[0.2458]
	{0.639}	{0.286}	{0.670}	{0.152}	{0.185}	{0.997}	{0.665}
Used Vacuum*	0.0378	0.1959	0.0301	-0.1947	0.1214	0.0029	0.0173
	(0.0619)	(0.1172)	(0.0602)	(0.1918)	(0.0535)	(0.0905)	(0.0618)
	[0.0914]	[0.3980]	[0.0731]	[-0.4081]	[0.2718]	[0.0059]	[0.0460]
	{0.589}	{0.185}	{0.656}	{0.248}	{0.076}	{0.740}	{0.849}
N	23,639,438	2,657,393	20,982,045	940,378	622,569	664,402	13,108,946

* Cesarean population was dropped for this dependent variable analysis since this procedure is not used in case of cesarean section

See foot note for Table 3. { } p-value of exogeneity test

Table 7. Impact of Malpractice Risk on Various Outcomes,
Various Samples, Using the Amount of OB/GYN Claims Paid per Births as a Measure of Risk

		History		Complications			S.E.S
Outcome	All births	Previous cesarean section	No previous C-sec.	Breech	Gest. Diabetes	Multiple Birth	≤ HS Degree
			OLS Estimates, Amount of OB/GYN Claims Paid/Birth in $1,000				
C-section Delivery	-0.0101 (0.0221) [-0.0032]	-0.0750 (0.0784) [-0.0073]	0.0127 (0.0182) [0.0057]	-0.1121 (0.1873) [-0.0976]	-0.0749 (0.0504) [-0.0155]	-0.0393 (0.0655) [-0.0532]	-0.0031 (0.0232) [-0.0010]
Prenatal Visits	0.0780 (0.5577) [0.0004]	0.0562 (0.5478) [0.0003]	0.0857 (0.5626) [0.0005]	1.1031 (0.6797) [0.0071]	0.6517 (1.0046) [0.0038]	0.9994 (0.8757) [0.0059]	0.5128 (0.6557) [0.0033]
At least one Ultrasound	0.5577 (0.3518) [0.0655]	0.6749 (0.3489) [0.0746]	0.5443 (0.3529) [0.0644]	0.5595 (0.3261) [0.0574]	0.4475 (0.2521) [0.0488]	0.6123 (0.3603) [0.0663]	0.4802 (0.3038) [0.0562]
Had amnio-centesis	0.0750 (0.0418) [0.1707]	0.1206 (0.0558) [0.1676]	0.0697 (0.0401) [0.1735]	0.0960 (0.0617) [0.1334]	0.0973 (0.0452) [0.0820]	0.1354 (0.0517) [0.1654]	0.0405 (0.0204) [0.1509]
Had fetal monitoring	-0.0215 (0.0905) [-0.0019]	-0.0606 (0.1016) [-0.0057]	-0.0194 (0.0908) [-0.0017]	-0.0588 (0.0873) [-0.0053]	-0.0233 (0.0828) [-0.0020]	-0.0420 (0.1099) [-0.0039]	-0.0283 (0.0833) [-0.0024]
Used Forceps*	0.0440 (0.0216) [0.0662]	0.1117 (0.0407) [0.1439]	0.0413 (0.0213) [0.0625]	0.1569 (0.0624) [0.1051]	0.0220 (0.0504) [0.0284]	0.0553 (0.0319) [0.0721]	0.0397 (0.0212) [0.0667]
Used Vacuum*	0.0097 (0.0215) [0.0091]	0.1251 (0.0472) [0.0995]	0.0052 (0.0216) [0.0049]	-0.0045 (0.1257) [-0.0037]	0.0321 (0.0294) [0.0289]	-0.0183 (0.0341) [-0.0151]	0.0130 (0.0214) [0.0132]
N	23,639,438	2,657,393	20,982,045	940,378	622,569	664,402	13,108,946

* Cesarean population was dropped for this dependent variable analysis since this procedure is not used in case of cesarean section
See foot note for Table 3.

Table 8. Impact of Malpractice Risk on Various Outcomes,
Various Samples, Using the Amount of OB/GYN Claims Paid per Births as a Measure of Risk

Outcome	All births	History: Previous cesarean section	History: No previous C-sec.	Complications: Breech	Complications: Gest. Diabetes	Complications: Multiple Birth	S.E.S: ≤ HS Degree
2SLS Estimates, Amount of OB/GYN Claims Paid/Birth in $1,000							
C-section Delivery	0.0262	-0.3606	0.0575	-0.1971	-0.0718	-0.0887	0.0319
	(0.1108)	(0.4168)	(0.0935)	(0.4329)	(0.1601)	(0.1837)	(0.1240)
	[0.0084]	[-0.0355]	[0.0261]	[-0.1716]	[-0.0149]	[-0.1202]	[0.0103]
	{0.724}	{0.441}	{0.612}	{0.812}	{0.983}	{0.775}	{0.763}
Prenatal Visits	-4.0906	-4.1888	-4.0494	-4.3970	-8.2019	-7.5293	-1.7111
	(2.6960)	(2.7560)	(2.6969)	(2.9430)	(3.6181)	(5.7066)	(3.0602)
	[-0.0261]	[-0.0269]	[-0.0259]	[-0.0284]	[-0.0486]	[-0.0444]	[-0.0111]
	{0.095}	{0.100}	{0.098}	{0.041}	{0.008}	{0.104}	{0.430}
At least one Ultrasound	0.4794	1.2750	0.3792	1.1461	1.0582	1.2509	0.6041
	(0.4856)	(0.6359)	(0.4796)	(0.6779)	(0.6253)	(0.6590)	(0.5284)
	[0.0563]	[0.1409]	[0.0449]	[0.1177]	[0.1154]	[0.1354]	[0.0707]
	{0.870}	{0.323}	{0.731}	{0.367}	{0.292}	{0.333}	{0.812}
Had amnio-centesis	0.2786	0.5392	0.2448	0.3271	0.5398	0.6053	0.2161
	(0.1317)	(0.2003)	(0.1217)	(0.1774)	(0.2125)	(0.2511)	(0.0875)
	[0.6342]	[0.7494]	[0.6095]	[0.4547]	[0.4551]	[0.7397]	[0.8052]
	{0.104}	{0.031}	{0.130}	{0.182}	{0.030}	{0.051}	{0.036}
Had fetal monitoring	0.3096	0.1802	0.3219	0.2819	0.1415	-0.0100	0.4394
	(0.5231)	(0.6453)	(0.5124)	(0.4985)	(0.4671)	(0.5065)	(0.5122)
	[0.0277]	[0.0172]	[0.0287]	[0.0258]	[0.0125]	[-0.0009]	[0.0385]
	{0.498}	{0.691}	{0.475}	{0.471}	{0.707}	{0.945}	{0.334}
Used Forceps*	0.2093	0.4907	0.1960	0.4023	0.2731	0.0949	0.2146
	(0.1450)	(0.1895)	(0.1426)	(0.2514)	(0.2061)	(0.1739)	(0.1488)
	[0.3150]	[0.6324]	[0.2970]	[0.2696]	[0.3534]	[0.1238]	[0.3608]
	{0.237}	{0.042}	{0.260}	{0.305}	{0.202}	{0.816}	{0.221}
Used Vacuum*	0.0588	0.4424	0.0403	-0.1679	0.1118	0.0114	0.0187
	(0.0752)	(0.1675)	(0.0714)	(0.2851)	(0.1043)	(0.1168)	(0.0722)
	[0.0556]	[0.3521]	[0.0383]	[-0.1392]	[0.1009]	[0.0094]	[0.0191]
	{0.472}	{0.050}	{0.589}	{0.522}	{0.410}	{0.769}	{0.936}
N	23,639,438	2,657,393	20,982,045	940,378	622,569	664,402	13,108,946

* Cesarean population was dropped for this dependent variable analysis since this procedure is not used in case of cesarean section
See foot note for Table 3. { } p-value of exogeneity test

Table 9. Descriptive statistics of measured risks in Obstetrics, Marginal Patient Sample

	Number of OB/GYN Claims/1000births	Amount of OB/GYN Claims Paid/Birth in $1,000
1%	0.0669	0.0155
5%	0.0990	0.0272
25%	0.1402	0.0390
50%	0.1687	0.0607
75%	0.2175	0.0906
95%	0.3081	0.1591
99%	0.4318	0.2120
Mean	0.1860	0.0712

Table 10. Impact of Malpractice Risk on Cesarean section, Marginal Patient Sample

Risk Measure	Cesarean Section
OLS Estimates Dependent variable: Cesarean Section	
Number of OB/GYN Claims/1000births	-0.0127 (0.0420) [-0.0094]
Amount of OB/GYN Claims Paid/Birth in $1,000	-0.0023 (0.0651) [-0.0006]
First Stage Estimates	
Number of non-OB/GYN Claims/1000population	3.75 (0.77)
Amount of non-OB/GYN Claims	4.87

Paid/Population in $1,000	(1.26)
2SLS Estimates	
Dependent variable: Cesarean Section	
Number of OB/GYN Claims/1000births	-0.1649 (0.1234) [-0.1225]
Amount of OB/GYN Claims Paid/Birth in $1,000	-0.2395 (0.2777) [-0.0681]
Exogeneity Test (P value)	
Number of OB/GYN Claims/1000births	0.149
Amount of OB/GYN Claims Paid/Birth in $1,000	0.355
N	5,834,291

Predicted cesarean section rate is calculated for each individual using 32 pregnancy related conditions such as blood pressure etc. I rank each individual based on predicted cesarean section rate by descending order. I use sub sample of 12.5th percentile to 37.5th percentile taking into account that c-section rate of around 23 percent for all births as a marginal patients whose procedure choice are more responsive when malpractice risks for doctors are changed.
Standard errors are clustered by state.