Note to the faculty.

This is the first draft of the paper. Any comments about the identification strategy, the empirical methodology or the analysis more generally will be greatly appreciated.

I am looking forward to hearing your comments.

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The Impact of Tort Reform on Intensity of Treatment: Evidence from the Heart Patients

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Abstract

This paper employs a unique data set comprised of a large sample of hospital in-patients to analyze the effect of tort reform on physician behavior. We examine a sample of 550,000 individuals aged 30 to 64 diagnosed as having had a heart attack between the years 1998 and 2005. We consider a number of different measures of intensity of treatment, including (1) total charges; (2) whether any procedure was done; (3) the number of procedures; (4) the length of stay and (5) the choice of major interventions (angioplasty versus bypass). We find that tort reform decreases intensity of treatment without increasing the in-hospital death rate. More importantly for inference, the reduction in intensity is more pronounced for the young, the group that poses the greatest liability risk, suggesting that tort reform may have reduced defensive medicine. In addition, we find no evidence that tort reform increased intensity of treatment for those covered by insurance, suggesting that tort reform did not increase "induced demand" "or "offensive medicine".

I. INTRODUCTION

This paper uses a large dataset to examine the effects of tort reform on the intensity of treatment of heart patients. Heart disease, which includes heart attacks and related complications caused by blockages in vessels supplying blood to the heart, is a leading cause of death in the United States and accounts for nearly one-seventh of all medical spending.[1] To test for effects of tort reform on "defensive medicine," we consider the differential impacts of reform by age. Younger patients pose greater liability risk due to higher expected damages, both economic and non-economic. Care of older patients therefore should be less sensitive to reform. Loss of wages, reduction in life expectancy, and expected duration of pain and suffering are all substantially less for someone aged 64 relative to a 30-year-old. In particular, a cap on non-economic damages should impact the younger patients more, as it would be less likely to bind on older patients.

We also wish to test whether tort reform led to more unnecessary (but lucrative) procedures, so-called "induced demand" or "offensive medicine." We hypothesize that offensive medicine is more likely to occur among those with insurance, who on average are much more likely to pay. Thus, if tort reform increases offensive medicine, this should be detected among those most able to pay.

We find that tort reform reduces intensity of treatment in urban hospitals and that this effect is larger for younger patients. We also find a contrary small increase in intensity of treatment in rural hospitals, though the standard errors here are large. Finally, we find no differential effects in treatment intensity by insurance coverage status.

[1] Cutler D., McClellan M., Newhouse J., & Remler D., Are Medical Prices Declining? (NBER Working Paper 5750, 1996).

This suggests that doctors do not react to tort reform by increasing the treatment intensity directed towards those most able to pay. The question of whether reform has moved us closer or further away from optimal levels of care remains. Our only quality variable, probability of death in hospital, is not ideal, but after reform it changes little or decreases slightly for urban hospitals. Death in hospital, however, is at best a weak indicator of quality, and therefore we draw only the most cautious conclusions about the effect of reform on overall welfare. In addition, probability of death may increase in rural hospitals after reform, which is consistent with some recent findings in the literature suggesting that tort reform may increase care by lower-quality providers.

In sum, our findings suggest that tort reform reduces intensity of treatment without increasing death rates, which is most consistent with the defensive medicine story. The rest of the paper is organized as follows. Part II surveys the theoretical background on tort reform and intensity of treatment. Part III discuss the identification strategy and data, Part IV discusses the results, and Part V contains our conclusions.

II. THEORETICAL BACKGROUND

One of the most powerful arguments against the present American system of medical malpractice liability is that it causes doctors to practice "defensive medicine" without providing offsetting benefits.[2] By defensive medicine we mean the practice of prescribing unnecessary (or non-cost-justified) tests, procedures, and medications as liability shields. Defensive medicine can also be achieved through avoidance of high-risk patients by either screening patients or leaving high-risk states and practice areas.

[2] Daniel Kessler & Mark McClellan, *Do Doctors Practice Defensive Medicine?,* 111 Q.J. Econ. 353 (1996); Avraham and Schanzenbach (2007).

Defensive medicine in theory may be pervasive due to agency problems in physician-patient-insurer relationships. Doctors do not bear the full costs of prescribing tests or procedures because third parties often reimburse them, but they may bear significant costs for medical liability. Although most physicians are substantially insured against malpractice claims, many doctors still report practicing defensive medicine. In fact, a recent survey found that ninety-three percent of Pennsylvania doctors sometimes or often engage in defensive medicine practices.[3] While the main motivation for defensive medicine may be due to the direct costs of liability, other factors also contribute. These include the desire to avoid reputational harm, decreased self-esteem from bad publicity, and the lost time and unpleasantness associated with defending a claim.[4] Thus, defensive medicine increases doctors' overall net income by decreasing their exposure to malpractice liability. To the extent defensive medicine occurs, tort reform should reduce doctors' incentives to practice it.

On the other hand, other agency problems could be exacerbated by tort reform. For example, tort reform may increase the practice of "induced demand" or "offensive medicine"—the tendency of doctors to increase their compensation by prescribing unnecessary tests and procedures. Tort reform may increase this practice by reducing the liability exposure for unnecessary (especially risky) procedures.

There is a large literature on induced demand for physician services, with much of it focusing on Caesarean section rates. A recent paper by Currie and MacLeod (2007) explored the effect of tort reform on C-section rates, allowing for differing impacts by reform. They found that that caps on damages increase unnecessary C-sections as well as

[3] David M. Studdert et al., *Defensive Medicine Among High-Risk Specialist Physicians in a Volatile Malpractice Environment*, 293 JAMA 2609, 2612 (2005).
[4] Kessler & McClellan, *supra* note 2, at 354.

the chance of complications in labor and delivery. They attribute these effects to lowered care-taking and more aggressive treatment resulting from limitations on liability. Of course, the ability to perform offensive medicine is limited by the ability of doctors to be reimbursed, which may be limited if the patient is uninsured or if the government reimbursement schemes are under-compensatory. Additionally, Currie and MacLeod found that the joint and several liability reform decreased C-section rates by placing *more* liability on the physician making the decision.

Apart from Currie and MacLeod, defensive and offensive medicine have been studied separately in the literature. There have been several studies attempting to detect evidence of defensive medicine. Some employ physician surveys, but of course physicians have an interest in showing that defensive medicine does exist to advance their self-interest in limiting their liability via tort reform.[5] Other studies have examined the effect of tort law changes on specific procedures, generally focusing on obstetrics patients (sometimes finding that medical malpractice leads to defensive medicine)[6] or on heart patients (with more mixed results.)[7] However, a recent, more general, study by

[5] See Studdert er al, supra note 2 (surveying 824 physicians of whom 93% reported practicing defensive medicine); U.S. Cong., Office of Tech. Assessment (OTA), *Defensive Medicine and Medical Malpractice,* at 41 (U.S. Gov't Printing Office, OTA-H-602, 1994) [hereinafter OTA 1994]; *see also* Kessler & McClellan, *supra* note 2, at 358-59 (noting that surveys only provide information about what treatments doctors say they administer, not behavior in real situations).

[6] *See* Localio AR, et al., *Relationship between Malpractice Claims and Cesarean Delivery*, 269 JAMA. 336 (1993) (finding association between malpractice claims risk and the rate of cesarean delivery in the state of NY in 1984); Dubay, L., R. Kaestner, & T. Waidmann, *The Impact of Malpractice Fears on Cesarean Section Rates*, 18(4) *J. of Health Economics* 491 (1999) (greater malpractice pressure leads to a higher probability of cesarean delivery for the period 1990–1992, without any significant improvement in health outcome); *but see* Sloan, F. A., K. Whetten-Goldstein, P. B. Githens, & S. S. Entman, *Effects of the Threat of Medical Malpractice Litigation and Other Factors on Birth Outcomes*, 33 *Medical Care* 700 (1995) (no systematic improvement in birth outcomes due to medical malpractice pressure); Baldwin LM, et al., *Defensive Medicine and Obstetrics*, 274 JAMA 1606 (1995) (No association between the malpractice exposure of individual physicians and an increase in the use of prenatal resources or cesarean deliveries for the care of low-risk obstetric patients).

[7] Kessler and McClellan, *supra* note 2, at 360-61 (finding defensive medicine for Medicare patients with AMI); Dhankhar P., Khan M., & Bagga S., *Effect of Medical Malpractice on Resource Use and Mortality of AMI Patients*, J. EMPIRICAL LEGAL STUDIES (Volume 4, Issue 1), 163–183, March 2007 (Using the same

Baicker, Fisher and Chandra (2007) found that a 10 percent increase in average malpractice liability payments per physician within a state was associated with a 1.0 percent increase in Medicare payments for total physician services and a 2.2 percent increase in the imaging component of these services. The authors did not find that higher malpractice liability costs were associated with reductions in total or disease-specific mortality, potentially indicating that these increases in payments are the result of, and evidence of, defensive medicine.[8]

Studies exploring offensive medicine, often referring to it as "induced demand," estimate the cost of excessive care as a result of insurers' reimbursement schemes, physician-owned hospitals, the increase in self-referral, and some other conditions that might provide incentives for doctors to unnecessarily increase patient care.[9] In general however, these studies do not always distinguish induced demand from incentives to supply defensive medicine.[10] While there is some anecdotal evidence that offensive

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dataset as we use here, found that medical liability pressure pushes the medical care system toward an optimal use of health-care resources.)

[8] Baicker K., Fisher E., & Chandea A., *Malpractice Liability Costs and The Practice of Medicine In The Medicare Program*, 26 HEALTH AFF (MILLWOOD) 841 (2007).

[9] *See, e.g.* Jonathan Gruber & Maria Owings, *Physician Financial Incentives and Cesarean Section Delivery*, 27 RAND J. Econ. 99 (1996) (suggesting physicians substituted c-section delivery for normal delivery in order to make up for negative income shocks from decreased fertility rates); Janet Currie & W. Bentley Macleod, *First Do No Harm? Tort Reform and Birth Outcomes* 3 (Nat'l Bureau of Econ. Research, Working Paper No. 12478, 2006) ("Many doctors perform unnecessary procedures not primarily because of fear of liability but because such procedures are more profitable . . . than the alternatives."), Janet Currie et al., *Physician Payments and Infant Mortality: Evidence from Medicaid Fee Policy*, 85 Am. Econ. R. 106 (1995) (Medicaid fee reimbursement); Stuart Guterman, *Specialty Hospitals: A Problem or a Symptom?,* 25 Health Affairs 95 (2006) (specialty hospitals and physician self-referral); Gruber & Owings, *supra* note 5 (negative income shocks from declining fertility rates). D. Card, C. Dobkin & N. Maestas, *Does Medicare Save Lives?* (NBER Working Paper 13668, available at http://www.nber.org/papers/w13668).(Medicare eligibility is associated with significant increases in hospital list chargers, the number of procedures performed in hospital, and the rate that patients are transferred to other care units in the hospital.)

[10] *See, e.g.,* Gruber & Owings, *supra* note 5, at 101 and 118-19 (noting "mixed results" in studies of correlation between malpractice threat and c-section delivery and noting that doctors may be forced to use c-section due to malpractice cases and the local standard of care but not discussing defensive incentives).

medicine actually exists in cardiac care, this is the first study to systematically investigate this issue.[11]

III. IDENTIFICATION STRATEGY AND DATA

As the previous section showed, the effect of tort reform on intensity of treatment is ambiguous. For example, if doctors perform excessive care to lower their risk of liability, then tort reform may reduce treatment intensity. By contrast, tort reform may increase treatment intensity because risky and/or unnecessary procedures become more profitable. We develop an identification strategy that tests for both offensive and defensive medicine. In essence, we argue that defensive medicine should be greater among the young and exploit the differential effect reform should have across age groups. Offensive medicine, however, should be practiced mainly against the insured, since they can more easily pay for the excessive procedures.

The best available evidence suggests that the old and the poor are less likely to sue.[12] Because medical malpractice claims are handled on a contingency fee basis, the

[11] In 2002 officials at the Redding Medical Center in California (also known as "little house of horrors") were subject to an FBI investigation which discovered that up to 50% of the 1000 bypasses a year (three times the normal rate for a facility its size) were not medically justified. The hospital eventually settled for more than $450 million with patients and the government. *See* Stephen Klaidman, "Coronary: A True Story of Medicine Gone Awry" (Simon and Schuster, 2007). This is of course not the first time in the history of the U.S that doctors admit patients for offensive medicine-related reasons. *See* Paul Jacobs, "Heart Surgeries Lead Hospital Into Difficulties", Los Angeles Times (7/31/1980) Page B1 (reporting that doctors at Paramount General Hospital in California were "anxious to operate on almost anything"). And *see also* Klaidman id pp. 7-11 (reporting how officials from the Psychiatric Institutes of America in Texas bribed doctors to refer patients to PIA. A 1993 FBI investigation ended with some doctors sent to jail and $379 million paid in fines and settlements with plaintiffs who had been wrongly admitted to the psychiatric institution.)

[12] Studdert DM, Thomas EJ, Burstin HR, Zbar BIW, Orav EJ, Brennan TA: Negligent care and malpractice claiming behavior in Utah and Colorado. *Medical Care* 38:250, 2000; Burstin HR, Johnson WG, Lipsitz SR, Brennan TA: Do the poor sue more?: A case-control study of malpractice claims and socioeconomic status. *JAMA* 270:1697,1993; Frederick C. Dunbar and Faten Sabry, The Propensity To Sue: Why Do People Seek Legal Actions? Business Economics (April 2007)(Figure 1). William Sage, The Role of Medicare in Medical Malpractice Reform. Journal of Healthcare Law and Policy Vol 9(2) 217 pp 222-225 (2006).

relatively low expected damages (which include future loss of income and future pain-and-suffering) for the old and poor might not appeal to trial lawyers. Indeed a 1992 study by the OTA not only found no evidence that Medicare and Medicaid patients sue more than other groups (as some have asserted) but rather that in fact they may sue less often.[13] The defensive medicine hypothesis suggests that excessive care will be provided primarily to younger patients. Younger patients will have, all else being equal, higher expected damages than older patients, and therefore impose a much higher risk of liability to doctors. Limitations on recovery, such as caps on non-economic damages, would be more likely to bind for younger patients. In short, according to the defensive medicine hypothesis, tort reform makes it relatively less risky (cheaper) to abstain from providing excessive care, especially to the young.

In contrast, the offensive medicine hypothesis suggests that people with insurance receive excessive care held in check by providers' fear of liability associated with the excessive care. Therefore, enactment of tort reform will cause insured patients to receive *more* care than before, all else being equal. In short, according to the offensive medicine hypothesis, tort reform makes it relatively cheaper to provide excessive risky care especially to the insured.

Separating these two strands is very important for gauging the social-welfare consequences of tort reform. We consider a number of different measures of intensity of treatment, including (1) total charges; (2) whether any procedure was done; (3) the number of procedures; (4) length of stay in the hospital. (5) whether a major intervention

[13] Herdman R, Behney CJ, Wagner JL, etal.: Do Medicaid and Medicare patients sue physicians more often than other patients? Office of Technology Assessment, Congressional Board of the 102d Congress, 1992.

(angioplasty versus bypass) is done at all, and (6) which of the major interventions, CABG or PTCA, was done. (See Table B).

Specification of Tort Reforms

While controlling for several types of reforms we focus our attention on a single type of reform: caps on non-economic damages.[14] See Table C. Non-economic damages are damages for anything beyond loss of income and direct medical costs. These damages are usually awarded for intangible losses, such as pain and suffering, loss of consortium, and hedonic (loss of enjoyment of life) damages. These damages may constitute a significant portion of total recovery, by some estimates up to 50%.[15]

We control for other reforms that were enacted in the period (reforms to joint and several liability rules, periodic payment reform, limitations to punitive damages, and collateral source reform). Only two or three states adopted each of these other reforms in the period under study and consequently were excluded from our analysis. However, as a robustness check, we test for the cumulative effect of all reforms with a reform variable that is a simple count of reforms. In this case, we have 20 states that changed the number of reforms in the sample period, and we find very similar results.[16]

Coding of Tort Reforms

We date tort reforms using the third edition of the Database of State Tort Law Reforms (DSTLR). This dataset was compiled by Avraham and discussed at length in

[14] As a robustness check, we include
[15] See Ronen Avraham, *Putting a Price on Pain and Suffering Damages: A Critique of the current approaches and a Preliminary Proposal for Change*, 100 Northwestern Univ. Law Rev 87, 87 (2006).
[16] This draft does not have it.

Avraham (2006).[17] The database was assembled by reviewing the laws and court cases of the 50 states (and Washington, D.C.) from 1980 to 2007 and comparing them to existing tort law compilations.[18] The process discovered that commonly-used dating schemes suffer from missing reforms, missing or erroneously coded effective dates of reforms, and missing or incorrectly coded state Supreme Court decisions striking down or upholding reforms. We believe the DSTLR (3rd) to be the most comprehensive legal dataset on tort reform to date. In this study we used the DSTLR (3rd)(CLEVER), which includes various modifications to DSTLR (3rd). In particular, states with caps which were very high, or where struck down within 3 years of enactment, or had built-in exceptions that made them toothless, were coded as not having caps because these caps were unlikely to have any effect. The results are much weaker if the broader definitions are used.

In-Patient Data

The Healthcare Cost and Utilization Project (HCUP) was developed through a Federal-State-Industry partnership and sponsored by the Agency for Healthcare Research and Quality (AHRQ). The Nationwide Inpatient Sample (NIS) is the largest all-payer inpatient care database that is publicly available in the United States. The data sample between 5 and 8 million hospital stays in about 1,000 hospitals sampled per year. This to approximates a 20-percent stratified sample of U.S. community hospitals.[19] The NIS is available for an 18-year time period, from 1988 to 2005, allowing analysis of trends over time. Whereas in 1988 there were only 8 states in the NIS, by 2005 there were 37 (see

[17] The dataset is available for free download at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=902711
[18] The compilations include: The American Tort Reform Association State and Federal Reforms compilation (available at http://www.atra.org/reforms/); A compilation by the National Conference of State Legislators, available at: http://www.ncsl.org/standcomm/sclaw/medmaloverview.htm; American Medical Liability Association's Comparison of State Medical Liability Laws; Westlaw's compilation of 50 State Surveys, Medical Malpractice-Tort Reform; CRS Report for Congress; Medical Malpractice Liability Reform: Legal Issues and Fifty-State Survey of Caps on Punitive damages and Non economic Damages (February 2005), available at: http://shelby.senate.gov/legislation/MedicalMalpractice.pdf.
[19] This universe of U.S. community hospitals is divided into strata using five hospital characteristics: ownership/control, bed size, teaching status, urban/rural location, and U.S. region.

Table A). However, the AHRQ recommends using the data only for years 1993 and later in longitudinal analysis.[20]

The NIS comes with a sorting tool that allows us to isolate the procedures in question while avoiding complications that arise from the periodic changes to the ICD-9-CM coding system, which is the coding system commonly used to diagnoses and procedures associated with hospital utilization in the United States. In addition, the dataset includes many relevant variables: hospital characteristics, patient characteristics, physician identifier, primary payer (self-paid, private insurance, government), patient diagnosis and treatments, disease severity and stage, in-hospital mortality, number of procedures performed, length of stay in hospital, and hospital charges.

Our reduced data set of patients aged 30 to 64 is comprised of more than 740,000 patients diagnosed with AMI in years 1993-2006.[21] Physicians can use any of the following three treatments: medical management, Percutaneous Transluminal Coronary Angioplasty (PTCA), and Coronary Artery Bypass Graft (CABG) surgery. Of the 740,000 patients in our dataset, about 200,000 receive CABG and 540,000 receive PTCA; (see Table B). In the data, very few PTCAs are followed by CABGs. However, because the data only reflect discrete hospital stays, we cannot tell how many patients are later readmitted with complications or who require additional procedures.

[20] Analyses of time trends are recommended from 1993 forward. See the report, *Using the HCUP Nationwide Inpatient Sample to Estimate Trends,* available on the HCUP User Support (HCUP-US) Website for details.

[21] Specifically, we look at all patients which single-level CCS diagnoses in anyone of the 15 diagnosis variables is equal to 100. CCS (Clinical Classification Software) is a tool for clustering more than 13,600 patient IDC-9-CM diagnoses into 231 clinically meaningful categories.

General Estimates of Intensity of Treatment

We explore the impact of tort reform on offensive and defensive medicine in two ways. First, we test whether tort reform changes the intensity of treatment of people diagnosed with acute myocardial infarction (AMI). As discussed, the defensive medicine hypothesis suggests that that tort reform will reduce the intensity of treatment for the young, and offensive medicine hypothesis suggests that tort reform will increase the intensity of treatment for the insured.

We first estimate the following equation:

$$(1)\text{Outcome}_{ijt}=\alpha\text{Constant}+\lambda\text{Year}_t+\psi\text{Hospital}_j+\tau\text{Age}_{ijt}+\rho\text{Insurance}_{ijt}+\tau\text{Demographic}_{ijt}+\sigma\text{TortReform}_{jt}+\delta\text{Tort Reform}_{jt}\,x\text{Age}_{ijt}+E_{jt}$$

Where *i* indexes individual, *j* indexes hospital, and *t* indexes year. *Outcome*, our dependent variable, is one of the following: log of charges, whether the patient received any procedure at all, the number of procedures, length of stay in the hospital, and whether or not the patient died in hospital. *Hospital* are hospital fixed-effects. Because we have hospital dummies, many hospital-level characteristics such as (1) ownership (public or private), (2) for-profit status, and (3) teaching status, which do not change over time, are controlled for. We do include a third-order polynomial on the number of hospital beds, which does vary over time, but this was insignificant. Hospital dummies are perfectly collinear with state dummies, so no state dummies are included in the equation. *Insurance* is divided into three categories: self-paid/uninsured, government and private insurance (no distinction is made between HMO and traditional insurance in the data). The only *Demographic* variables (besides age, which will be discussed shortly) are sex and a three-category variable specifying median income of zip code in which patient

lives. The main variable of interest is δ, which tests for differential effects of tort reform by different ages. If either of the hypotheses is correct, the effect of tort reform should be decreasing in age. In the actual estimation, we will divide *Age* into four categories, ages 30 to 39; ages 40 to 49; ages 50 to 59; and ages 60 to 64. Cutting the age at 65 prevents us from having to worry about separating Medicaid and Medicare effects.

We next estimate the following equation:

$$(2)\ Outcome_{ijt}=\alpha Constant+\lambda Year_t+\psi Hospital_j+\tau Age_{ijt}+\rho Insurance_{ijt}+\varphi Demographic_{ijt}+\sigma TortReform_{jt}+\eta Age_{ijt}xInsurance_{ijt}+\delta Age_{ijt}xTortReform_{jt}+\tau Age_{ijt}xInsurance_{ijt}xTort\ Reform_{jt}+E_{jt}$$

This is the same equation as Equation 1, but adds (a) interactions between age and insurance status, (b) interactions between insurance status and tort reform, and (c) a three-way interaction between age, insurance status, and reform. Thus, the equation is a triple-difference with the parameter of interest being τ, which is the marginal effect of insurance coverage on the effect of tort reform by age category. If offensive medicine increases as a result of tort reform, intensity of treatment could increase for the insured relative to the uninsured.

Choice of Major Procedures: Bypass (CABG) vs. Angioplasty (PTCA)

In an extension of our approach, we hope to analyze the effect of tort reforms on the choice between two coronary revascularization procedures: PTCA (Percutaneous Transluminal Coronary Angioplasty)[22] and CABG (Coronary-Artery Bypass Graft).

The data enables us to distinguish between two types of patients. First, patients with diagnoses that *compel* a specific treatment, either CABG or PTCA. Second, patients with diagnoses that *allow* doctors some discretion whether to perform CABG, PTCA or

[22] PCI involves a procedure known as PTCA (Percutaneous Transluminal Coronary Angioplasty) and the terms are sometimes used interchangeably. See http://www.merck.com/mmpe/sec07/ch070/ch070h.html.

drug therapy. It is this latter group of patients for which we expect tort reform to have any effect. At a minimum, we can test the sensitivity of treatment choice to tort regimes.

Urban versus Rural Effects

For each specification we present results for rural, urban and both types of hospitals combined. We do this because the effect of tort reform on rural and urban hospitals is likely different. The literature on physician supply has found that tort reform increases physician supply in rural areas, but not in urban areas. This is most consistent with the idea that rural hospitals may be more sensitive to costs. For example, Baicker and Chandra[23] found that malpractice premiums do not affect the overall size of the physician workforce, although they may deter marginal entry, increase marginal exit, and reduce the rural physician workforce. On the other hand, Kessler et al found that the adoption of "direct" malpractice reforms led to 3.3% growth in the overall supply of physicians. [24] Direct reforms had a larger effect on supply through retirements and entries than through the propensity of physicians to move between states. In contrast, in a recent working paper Silver et al. have found no evidence that tort reform in Texas increased physician supply.[25] At least two studies found some differential effect of tort reform on rural and urban areas. Encinosa and Hellinger found an association between caps and an

[23] Katherine Baiker & Amitabh Chandra. *The Effect of Malpractice Liability on the Delivery of Health Care*, Working Paper No. 10709. National Bureau of Economic Research, Cambridge, Mass. (2004), available at http://www.nber.org/papers/w10709.
[24] Daniel P. Kessler, William M. Sage & David J. Becker, *Impact of Malpractice Reforms on the Supply of Physician Services*, 293 JAMA 2618 (2005).
[25] Silver C., Hyman D., & Black, The Impact of the 2003 Texas Medical Malpractice Damages Cap on Physician Supply and Insurer Payouts: Separating Facts from Rhetoric, U Illinois Law & Economics Research Paper No. 08-028.

increased supply of physicians in sensitive specialties in rural areas. [26] Recently, David Matsa used county-level, specialty-specific annual counts of physicians from 1970 to 2000 to estimate the effect of damage caps on physician supply.[27] He found that caps do not affect physician supply for the average resident of states adopting reforms, but increase the supply of rural specialist physicians by 10-12 percent. For a survey of older studies, see U.S. Government Accountability Office (2003).

IV. RESULTS

Tables 1a and 1b correspond to Equation 1 and Tables 2a and 2b correspond to Equation 2. The dependent variables are *Log Charge*, *Log of Length of Stay*, *Any Procedure* (equals 1 if any procedure was performed and zero otherwise), *Number of Procedures* (conditional on any procedure), and *Death*, (equals one if death occurred). Each equation is estimated for patients in rural hospitals and in urban hospitals.

In Tables 1a and 1b, the basic results of the non-reform variables are in line with intuition. (The excluded group is self-payers in their 30s in states without tort reform.) For example, total charges and the probability of death in the hospital rise with age and are higher for the governmentally insured. Interestingly, charges in rural hospitals and the probability of death are lower for the privately insured.

We start by analyzing the results for urban hospitals. Table 1a suggests that tort reform has no impact on *Charges*. Nonetheless we do not place a lot of reliance on these results because log charges are likely a noisy variable. Hospital charges are not paid in

[26] William E. Encinosa & Fred J. Hellinger, *Have State Caps on Malpractice Awards Increased the Supply of Physicians?* HEALTH AFFAIRS Web exclusive, May 31, 2005, available at http://content.healthaffairs.org/cgi/reprint/hlthaff.w5.250v1.

[27] Matsa, David. 2005. Does Liability Keep the Doctor Away? Evidence from Tort Reform Damage Caps. *Journal of Legal Studies*, vol. 36 (June 2007).

full by the government, insurance companies, or the uninsured but are substantially discounted for by all three, potentially in different ways. Additionally, hospitals may pad their charges a fair bit so that reported charges may not always be strongly correlated with actual costs. To deal with this problem we translated the charges to actual costs based on various cost-to-charges ratio indices published by HCUP.[28] There are a couple of limitations to doing this. First, the indices are available only from 2001, whereas our study begins in 1993. As a result, the estimates of the impact of tort reforms on costs are less reliable than if they were based on the full range of the years. Second, as can be seen in Table 1a, we present two different indices for costs. HCUP publishes two types of indices. The first index is the charges-to-cost ratio at the hospital level. This could have been a good index, but for the many missing observations. To fix that problem HCUP publishes a second index which is the average ratio for a group of hospitals in a geographic area.

Based on the group level index, Table 1a shows that post tort reform *Costs* decrease in urban hospitals by 6.3% (for the oldest) to 7.6% (for the youngest). Based on the hospital level index, the reduction is by only 3.2% (for the oldest) to 4.5% (for the youngest). All results are significant at least at the 5% level. Table 1b reports our additional intensity measures. The results suggest that tort reform increases the *Length of Stay* by 1.6% (for the oldest) to 2.8% (for the youngest); results are significant at least at

[28] Our dataset contains data on total charges for each hospital in the databases. This charge information represents the amount that hospitals billed for services, but does not reflect how much hospital services actually cost or the specific amounts that hospitals received in payment. The HCUP Cost-to-Charge Ratio Files enable this conversion. Each file contains hospital-specific cost-to-charge ratios based on all-payer inpatient cost for most hospitals in the database. Cost information was obtained from the hospital accounting reports collected by the Centers for Medicare and Medicaid Services (CMS). Some imputations for missing values were necessary. *See* http://www.hcup-us.ahrq.gov/db/state/costtocharge.jsp

the 5% level, except for the oldest for which the results are not significant.[29] Tort reform seems to also affect the *Number of Procedures* in urban hospitals. Specifically, after tort reform, the *Number of Procedures* in urban hospitals decreases by -.15 for the youngest (30 to 39) to -.03 for the oldest (60 to 64). These results however are only jointly significant. *Death* in hospital, our only quality measure, is reduced in urban hospitals by .003 (significant at the 5% level) but only for the old. Taken together, the results suggest that, after tort reform, while patients (especially young patients) in urban hospitals stay longer, they receive fewer procedures, and therefore potentially incur fewer costs and yet are *not* more likely to die in the hospital. In fact, if old they are less likely to die in hospital. These results are consistent with the hypothesis that doctors in urban hospitals in states without tort reform perform defensive medicine, which is potentially dangerous to old patients.[30]

Table 2 adds interactions with insurance status to gauge the presence of offensive medicine. The Age*Reform coefficients are now main effects, hence the *Age*Reform*Priv. Ins.* and *Age*Reform*Gov't Ins.* interactions are the marginal effect of insurance status for the age category. The joint test of the *Age*Reform*Insurance* coefficients therefore tests whether reform had a differential impact by insurance category (p-value is reported).

Tables 2a and 2b show that, as before, log of *Charges* and chance of *Death* rise with age. As for the impact of tort reform in urban hospitals, the *Log Charges* results in

[29] When we analyze log of length of stay for cases where length of stay is larger than 1, the coefficients become smaller and often less significant. Thus, length of stay increases may represent increased admissions, which would be consistent with lower avoidance of risky patients.

[30] That increases in use of care could actually lead to harm is explained in E.S. Fisher & H.G. Welch, *Avoiding the Unintended Consequences of Growth in Medical Care: How Might More Be Worse?*, 281 JAMA 446 (1999) (hereinafter Fisher & Welch).

Table 2a replicates the results in Table 1a, suggesting little to no effect of reform and no differential effect by age or insurance status. However, like in Table 1a, the *Log Costs* results suggest that tort reform significantly reduces costs, primarily for the young. However, no differential impact was found based on insurance status. The hospital level index shows a similar yet smaller effect in magnitude and weaker in significance. Table 2b replicates the increase in *Length of Stay* post tort reform without revealing any differential effect by insurance status. Table 2b also reveals no differential effect for the decrease in the *Number of Procedures* in urban hospitals we detected in Table 1b. As before the reduction is larger for the young (-0.17) than for the old (-0.02) and the results are again only jointly significant.[31] Interestingly, Table 2b reveals that the probability of receiving *Any Procedure* increases for the *insured* young (both government and private insurance). Specifically, probability of admission increases by 1.9% (for people in their 30s who are privately insured) and by 2.3% for people in their 30s who are insured by the government. (Both results are significant at the 5% level). At least for the privately insured young, the increase in admission is desirable because their death rate decreases by 0.09. There was no detectable effect in *Death* rate for the government insured.

In sum, Tables 2a and 2b suggest that, in urban hospitals, tort reform decreases the *Number of Procedures* for the self-payers, and more so for the young self-payers. Despite an increase in the *Length of Stay* this may translate into reduction in costs, again larger for the young, with no detectable change in *Death* rate. This is consistent with the defensive medicine hypothesis. In addition, tort reform slightly increases the probability of receiving *Any Procedure* among the young-insured and that potentially decreases the chances of dying for the privately insured young.

[31] When we run the analysis on log of Number of Procedures, the results are not even jointly significant.

Moving to rural hospitals, Table 1a suggests that tort reform has no significant impact on *Charges*. Similarly, both the hospital level and the group level indices in Table 1a suggest tort reform has no impact on *Costs*. In contrast, reform does appear to have an effect on the *Length of Stay* and the probability of *Any Procedure* being undertaken for patients in rural hospitals. Specifically, Table 1b shows that after tort reform *Length of Stay* increase by 2.9% (for the oldest) to 7.3% (for the youngest); results are significant at the 5% level only for the youngest, and are jointly significant at the 10%. Table 1b also shows that probability of receiving *Any Procedure* in rural hospitals rises by 5.6 (for the young) to 6.3% (for the old) after tort reform; results are significant at the 1% level. Interestingly, after tort reform the *Number of Procedures* in rural hospitals may seem to increase by .12 to .18 but the results are neither individually nor jointly significant. Finally, tort reform seems to increase *Death* rate in rural hospitals by .006 to people in their 50s and 60s (results are significant at the 5% level). Taken together Tables 1a and 1b suggest that patients in rural hospitals post tort reform are more likely to be admitted to hospitals, stay longer and while this did not translate to larger costs, if the admitted patients are old they are more likely to die in the hospital.

Table 2a (which add interactions of reform and insurance status) does not show any significant effect of tort reform on *Charges* or *Costs*. In contrast Table 2b replicates the results from Table 1b and shows that tort reform increases *Length of Stay*, especially for the young; results are significant at the 1% level for the youngest, and are jointly significant. The *Any Procedure* results in Table 2b replicate results we detected in Table 1b, and suggest an increase of 4% (for the young) to 7.8% (for the old) post tort reform; results are mostly significant at the 5% level . Again, no differential effect for insured

individuals was detected. Table 2b also shows an increase of *Death* rate for uninsured people in their 50s, with an offsetting reduction in death rate for insured people in their 50s following tort reform. These results suggest that, in rural hospitals, tort reform causes hospitals to increase the intensity of treatment, and that this may have a negative impact on the chance of survival of the uninsured old.

In sum, our data suggests that, in urban hospitals, tort reform decreases intensity of care primarily for the young, and that this reduction in care reduces death in hospital primarily for the old. This result is consistent with the defensive medicine hypothesis that unnecessary procedures are being performed to limit liability. We note that about 90% of the patients in our dataset receive care in urban hospitals. Tort reform seems to also increase intensity of treatment in urban hospitals for the insured and that this may decrease the chances of dying of the privately insured.

In addition, in rural hospitals tort reform increases the probability of receiving any procedure and that potentially increases the chances of dying for the uninsured old. However, even if the increase in intensity of treatment is indeed beneficial to patients (as was the case in urban hospitals for the insured), and definitely if it is not (as was the case in rural hospitals for the uninsured), the problem of offensive medicine can still exist, as the treatment may not be *socially* beneficial. It is worth mentioning however that we did not find the differential effect of supplying treatment by insurance status that we expected under the offensive medicine hypothesis.

An important assumption we make in our identification strategy is that the young are more likely to sue. While we presented substantial evidence that this is true for the entire population, we did not present any evidence that is also true for the AMI patients.

Several epidemiological studies have found that young patients (i.e. patients aged 18-45) who suffer myocardial infarctions self-report abuse of cocaine, methamphetamine, or prescription stimulants in numbers ranging from 4% to 25%.[32] Additionally, these studies have relied on self-reporting, and self-reporting of cocaine use has been shown to under-report actual levels of use, resulting in figures as low as half the actual levels of use.[33] Because many of these young patients self-report stimulant abuse (and many more than that actually abuse stimulants but do not reveal this to their physicians), the assumption that younger patients are more likely to sue is complicated. Patients whose illegal drug use has caused a particular hospital visit are perhaps less likely to sue based on a potential incident of medical malpractice resulting from that visit: to do so would potentially expose the patient to legal ramifications and reputational harm. However, there is no data on the rate of lawsuits for AMI patients and in our study the youngest group is people in their 30s, so potentially this problem, to the extent it exists, is less prevalent that the cited studies suggest. In any case, when we ran the analysis on people

[32] A.I. Qureshi, M.F. Suri and L.R. Guterman et al., Cocaine use and the likelihood of nonfatal myocardial infarction and stroke: data from the Third National Health and Nutrition Examination Survey, Circulation 103 (2001) (4), pp. 502–506 (finding that 25% of 18-45 year olds' heart attacks were attributable to self-reported cocaine use); Murray A. Mittleman, MD, DrPH; David Mintzer; Malcolm Maclure, ScD; Geoffrey H. Tofler, MB; Jane B. Sherwood, RN; James E. Muller, MD, Triggering of Myocardial Infarction by Cocaine, Circulation 99 (1999) pp. 2737-2741 (finding that 4% of young MI patients self-report cocaine use). Because of this prevalence of drug abuse in the young patient subpopulation, physicians are trained to incorporate the possibility of stimulants as a potential causal factor of chest pain and heart attack. Constantinos G Missouris, Pauline A Swift and Donald RJ Singer, Cocaine use and acute left ventricular dysfunction, The Lancet 357 (May 2001) (9268), p.1586 ("We propose that cocaine abuse should always be considered in the differential diagnosis in young patients admitted with atypical presentation of an acute coronary syndrome."); Gee Yen Shin and Philip Rice, Cocaine use and acute coronary syndromes, The Lancet 358 (October 2001) 9290, p. 1367 ("We agree with Constantinos Missouris and colleagues' proposal1 that cocaine use should always be considered in the differential diagnosis in young patients with atypical presentation of an acute coronary syndrome.")

[33] Lee MO, Vivier PM, Diercks DB., Is the Self-report of Recent Cocaine or Methamphetamine Use Reliable in Illicit Stimulant Drug Users Who Present to the Emergency Department with Chest Pain?, J Emerg Med. (2008), Date of Issue: 18 December 2008 (Article in Press) (finding that the self-report rate among cocaine- or methamphetamine-using patients presenting to the emergency department with chest pain was 51.8% compared to the number who had these drugs in their urine).

age 40 and above, most of the results remained, although they were weaker and less significant.

V. CONCLUSIONS AND FUTURE WORK

There are many ways to evaluate tort reforms. For example, deontologists may argue that caps are unconstitutional because they infringe upon certain legally-formulated patient's rights. We, however, take a consequentialist approach and are interested in the real-world impact of tort reform. Aside from policy makers' general interest in such an approach, we note that the measurable impact of tort reforms has important constitutional implications. State supreme courts have looked to various empirical studies on the impact of tort reform to determine whether a given tort reform is rationally related to some legislative objective (such as a reduction in health care costs) and thus constitutional.[34]

We used patients' age and insurance status to evaluate tort reform's effect on intensity of treatment. Reductions in defensive medicine should be sensitive to the age of the patient, while increases in offensive medicine should be sensitive to ability to pay. The bulk of the evidence presented here suggests that in urban hospitals tort reform decreased treatment intensity for younger patients without influencing their mortality rate. This is most consistent with the defensive medicine hypothesis. There is also some

[34] Compare Ferdon v. Wisconsin Patients Comp. Fund, 701N.W.2d 440 [Wis. 2005] (After examining various empirical studies on the impact of tort reform the Wisconsin Supreme Court, applying the rational basis test, struck down caps because the statute was not rationally related to the legislative objective of lowering malpractice insurance premiums and reducing overall health care costs only) with *Judd v. Drezga*, 103 P.3d 135 [Utah 2004] (Supreme Court of Utah upholding caps on the basis of the perceived reasonableness of the empirical studies relied on by the Utah legislature). And see more generally, Avraham, R. (2007). "The Impact of Tort Reforms on Medical Malpractice Settlement Payment" *Journal of Legal Studies* 36 (2), pp 183-229 at 185.

evidence that offensive medicine exists in rural hospitals, yet we did not detect the differential effect by insurance status that we expected. The choice of procedure was also influenced by tort reform. Fewer major procedures like PTCA or CABG were performed on the young after tort reform in urban hospitals. This is most consistent with the defensive medicine hypothesis. In addition, we find that tort reform increases the use of PTCA in rural hospitals. At this point we cannot explain this result. The fact that we found no evidence that reduction in intensity of treatment reduces mortality rates is not sufficient to rule out a potential disadvantage of the post-tort-reform-reduced intensity of care: reduced quality of life.[35]

In the future, we plan to more fully consider the implications of our findings so far. One methodological issue that we must consider is how to model the multiple treatment choices available to doctors. Multinomial choice models may be valid. In order to better isolate the possibilities for offensive medicine, hospital-level factors such as reimbursement schemes could also be considered. Hospital reimbursement schemes could matter greatly. While we did account for "real" costs and not just the charges, we still need to account for the problem of "gate keepers". That problem arises because the decision whether to refer the patient to PTCA or CABG is made by a referring cardiologist who, in some hospitals, can choose to perform the PTCA as an interventional cardiologist (thus being reimbursed for the very procedure she recommends).[36] Tort reform may induce different sets of incentives in such cases.[37]

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[35] See Fisher & Welch, *supra* note 31.

[36] Afendulis CC, Kessler DP, Tradeoffs from Integrating Diagnosis and Treatment in Markets for Health Care, American Economic Review, Vol 97(3) 2007 pp 1013-1020 (finding that diagnosis by an interventional cardiologist leads, on net, to higher health spending but similar health outcomes, relative to diagnosis by a non-interventional cardiologist, and that the net effect contains three components: reduced spending and improved outcomes from better allocation of patients to surgical treatment options; increased spending conditional on treatment option; and worse outcomes from poorer provision of nonsurgical care);

Denvir MA, Pell JP, Lee AJ, Rysdale J, Prescott RJ, Eteiba H, Walker A, Mankad P, & Starkey IR, Variations in Clinical Decision-Making between Cardiologists and Cardiac Surgeons; A Case For Management By Multidisciplinary Team? Journal of Cardiothoracic Surgery (2006) 1:2 (Finding that surgeons were more likely to choose surgery as a form of treatment while interventional cardiologists were more likely to choose PTCA but that there were no significant differences between non-interventional and interventional cardiologists in their choice of treatment).

[37] Finally, a consideration of other types of patients would also help to provide a fuller picture. For example, to our knowledge, the interaction between C-section rates, insurance status, and reform has not been studied, even though there is some evidence of offensive medicine in C-sections. Currie, Janet and Jonathan Gruber, *Public Health Insurance and Medical Treatment: The Equalizing Impact of the Medicaid Expansions*, 82 Journal of Public Economics 63-90 (2001) (finding that women with good insurance coverage are more likely to have C-sections).

Table A- States Included In The Analysis, 1993-2006

Year	Data sources	Number of hospitals	Number of discharges in the NIS, unweighted	Number of discharges in the NIS, weighted for national estimates
2000	AZ CA CO CT FL GA HI IL IA KS KY MD MA ME MO NC NJ NY OR PA SC TN TX UT VA WA WI WV *(Added KY, NC, TX, WV)*	994	7,450,992	36,417,565
2001	AZ CA CO CT FL GA HI IL IA KS KY MD MA ME MI MN MO NC NE NJ NY OR PA RI SC TN TX UT VA VT WA WI WV *(Added MI, MN, NE, RI, VT)*	986	7,452,727	37,187,641
2002	CA CO CT FL GA HI IL IA KS KY MD MA ME MI MN MO NC NE NJ NY NV OH OR PA RI SC SD TN TX UT VA VT WA WI WV *(Added NV, OH, SD; AZ data were not available)*	995	7,853,982	37,804,021
2003	AZ CA CO CT FL GA HI IL IN IA KS KY MD MA MI MN MO NC NE NH NJ NY NV OH OR PA RI SC SD TN TX UT VA VT WA WI WV *(Added AZ, IN, NH; ME data were not available)*	994	7,977,728	38,220,659
2004	AR AZ CA CO CT FL GA HI IL IN IA KS KY MD MA MI MN MO NC NE NH NJ NY NV OH OR RI SC SD TN TX UT VA VT WA WI WV *(Added AR; PA data were not available)*	1,004	8,004,571	38,661,786
2005	AR AZ CA CO CT FL GA HI IL IN IA KS KY MD MA MI MN MO NC NE NH NJ NY NV OH OK OR RI SC SD TN TX UT VT WA WI WV *(Added OK; VA data were not available)*	1,054	7,995,048	39,163,834

Table B- Summary statistics for years 1993-2006 in the NIS dataset

	All age groups, (N=725,557)		**Age group 30, (N=38,047)**		**Age group 40, (N=172,311)**		**Age group 50, (N=325,020)**		**Age group 60, (N=190,199)**	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Charges ($)	32,126	39,348	27,046	30,644	29,790	34,634	32,851	40,013	34,019	43,375
Costs ($)[39]	17,607	18,261	14,977	14,506	16,371	16,006	17,897	18,366	18,748	20,445
% receive any procedure	0.83	0.37	0.82	0.38	.84	.36	.83	.37	.80	.39
# of procedures (if >0)	3.7	2.65	3.52	2.47	3.7	2.5	3.7	2.6	3.63	2.75
Length of Stay (days)	4.83	5.7	3.99	4.28	4.25	4.7	4.83	5.52	5.5	6.86
% died	0.032	0.17	0.017	0.13	.018	.13	.030	.17	.050	.21
Age	53.4	7.5	36.0	2.58	45.3	2.72	54.7	2.82	62.0	1.37
% Female	0.27	0.44	.23	.42	.22	.42	.26	.44	.32	.46
Uninsured	.10	.30	.17	.38	.13	.33	.09	.29	.07	.26
Gov't Insurance	.22	.41	.22	.41	.18	.38	.20	.40	.27	.44
Private Insurance	.67	.46	.60	.48	.68	.46	.69	.45	.64	.47

[39] Costs are based on the group level index and are for years 2001 to 2006 only.

Table C: Changes in Number of States with Reforms (by adoption and judicial reversal) based on DSTLR 3rd (CLEVER)

Year	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**00**	**01**	**02**	**03**	**04**	**05**	**06**
Cap Non-Economic	8	8	9	12	12	12	12	12	12	12	14	18	21	22
Joint & Several	32	32	33	33	33	33	33	33	33	34	36	37	37	37
Collateral Source	31	31	31	31	29	29	29	29	30	32	33	34	34	34
Caps Punitive	14	14	15	18	19	20	20	22	22	22	22	23	24	25
Punitive Evidence	29	30	31	33	33	32	32	33	33	33	34	34	34	34
Periodic Payment	30	30	28	28	28	28	28	28	28	29	30	31	31	31
Split Recovery	4	4	4	5	5	5	5	5	5	6	6	6	8	9
Caps Total	7	7	7	6	6	6	6	6	6	6	6	6	6	6
Contingency Fee	15	15	15	15	15	15	15	15	15	15	15	15	16	16
Patient Comp' Fund	10	10	10	10	10	10	10	10	10	10	10	11	11	11

Table C presents the enactment and striking down of: Caps Non-Economic Damages, Joint & Several Liability, Collateral Source Rule, Caps Punitive Damages, Punitive Evidence, Periodic Payments, Split Recovery, Caps Total Damages, Contingency Fee reforms and Patient Compensation Fund. If a reform was enacted or struck down on or after July 1st, it was coded as enacted or struck down at the year after. The last column presents the number of variations of the reform from 1981 to 2004. It includes changes that are not reflected in the table. For example Oregon struck down caps on non economic damages in 2000. But since Maine enacted caps on non economic damages in 2000, the table shows no change. The last column counts this as two changes. Table 2 below shows one enactment and one strike down of caps on non economic damages in 2000. The difference between Table 1 and Table 3 is that Table 3 is based on DSTLR 3rd (CLEVER). For more detailed explanation on the differences see below.

Table 1a: The Impact of Caps on Charges and Costs By Age

	Log Charge		Log Costs (Group level index)		Log Costs (Hospital level index)	
	Rural	Urban	Rural	Urban	Rural	Urban
Age40	.060***	.077***	.040**	.075***	.047**	.077***
	(.008)	(.005)	(.018)	(.006)	(.021)	(.006)
Age50	.097***	.140***	.095***	.141***	.102***	.143***
	(.010)	(.005)	(.014)	(.006)	(.015)	(.006)
Age60	.121***	.180***	.108***	.179***	.119***	.180***
	(.013)	(.008)	(.022)	(.010)	(.026)	(.009)
Private Insurer	-.020*	.011	-.021*	.000	-.026*	.001
	(.011)	(.008)	(.011)	(.009)	(.013)	(.008)
Gov't Insurer	.043***	.035***	.062***	.038***	.056***	.036***
	(.010)	(.011)	(.016)	(.010)	(.019)	(.012)
Reform*Age30	.049	-.027	-.023	-.076***	.026	-.045**
	(.063)	(.029)	(.101)	(.023)	(.120)	(.021)
Reform*Age40	.086	-.022	.026	-.070***	.069	-.041***
	(.060)	(.027)	(.090)	(.019)	(.099)	(.014)
Reform*Age50	.083	-.023	.003	-.070***	.056	-.038**
	(.062)	(.026)	(.097)	(.020)	(.109)	(.016)
Reform*Age60	.079	-.026	.025	-.063**	.072	-.032
	(.059)	(.031)	(.091)	(.025)	(.099)	(.020)
Constant	9.558***	10.35***	9.383***	9.638***	8.959***	9.167***
	(.116)	(.098)	(.140)	(.113)	(.129)	(.109)
J. test of Reform Interactions	.15	.91	.66	.002	.57	.06
Observations	82587	642039	30466	261473	25486	230639
Number of Hospitals	1367	2200	1049	1546	816	1350

*- significant at the 10% level. **- significant at the 5% level. ***- significant at the *** level. Reform equals one if the state adopted caps on non-economic damages after 1993. Not reported are year effects, income, gender, hospital characteristics and several other tort reforms control variables. All standard errors are clustered by states. The excluded age category is 30 to 39; the excluded insurance category is self-paid. NIS data is for years 1993-2006. Reform data is from DSTLR 3rd (CLEVER).

Table 1b: The Impact of Caps on Charges and Costs By Age And Insurance Status

	Length of Stay		Any Procedure		Number of Procedures (If larger than 0)		Died in Hospital	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Age40	.087***	.053***	.006	.007**	.031	.128***	.006**	.004***
	(.010)	(.003)	(.006)	(.002)	(.033)	(.014)	(.002)	(.000)
Age50	.162***	.138***	.000	.001	.061*	.217***	.015***	.016***
	(.011)	(.004)	(.006)	(.002)	(.034)	(.021)	(.002)	(.000)
Age60	.223***	.209***	-.005	-.006**	.110**	.253***	.031***	.033***
	(.011)	(.008)	(.007)	(.002)	(.042)	(.029)	(.002)	(.001)
Private Insurer	-.036***	-.015*	.000	.015***	.011	.080***	-.012***	-.015***
	(.011)	(.008)	(.004)	(.002)	(.022)	(.015)	(.002)	(.001)
Gov't Insurer	.151***	.138***	-.023***	-.020***	-.040	-.033	.013***	.014***
	(.012)	(.007)	(.004)	(.003)	(.030)	(.026)	(.002)	(.001)
Reform*Age30	.073**	.028**	.056**	.003	.134	-.152	.007	.001
	(.035)	(.013)	(.027)	(.008)	(.258)	(.119)	(.005)	(.002)
Reform*Age40	.040	.026*	.058**	.007	.123	-.103	.003	.000
	(.036)	(.014)	(.026)	(.008)	(.257)	(.126)	(.003)	(.001)
Reform*Age50	.027	.022**	.062**	.007	.196	-.071	.006*	-.001
	(.034)	(.010)	(.024)	(.007)	(.251)	(.125)	(.003)	(.001)
Reform*Age60	.029	.016	.063**	.012	.188	-.032	.006*	-.003*
	(.031)	(.012)	(.026)	(.008)	(.243)	(.129)	(.003)	(.001)
Constant	.945***	1.201***	.638***	.871***	5.147***	3.475***	.12*	.034***
	(.079)	(.043)	(.061)	(.039)	(.434)	(.290)	(.006)	(.004)
J. test of Reform Interactions	.10	.17	.13	.33	.77	.06	.38	.42
Observations	83725	660738	83753	661482	46236	570610	83687	661120
Number of Hospitals	1371	2226	1371	2226	995	2083	1371	2226

*- significant at the 10% level. **- significant at the 5% level. ***- significant at the *** level. Reform equals one if the state adopted caps on non-economic damages after 1993. Not reported are year effects, income, gender, hospital characteristics and several other tort reforms control variables. All standard errors are clustered by states. The excluded age category is 30 to 39; the excluded insurance category is self-paid. NIS data is for years 1993-2006. Reform data is from DSTLR 3rd (CLEVER).

Table 2a: The Impact of Caps on Charges and Costs By Age

	Log Charges		Log Costs (Group level index)		Log Costs (Hospital level index)	
	Rural	Urban	Rural	Urban	Rural	Urban
Age40	.112***	.096***	.047	.086***	.046	.085***
	(.023)	(.014)	(.037)	(.014)	(.034)	(.015)
Age50	.161***	.166***	.127***	.145***	.139***	.142***
	(.022)	(.013)	(.043)	(.012)	(.046)	(.015)
Age60	.160***	.217***	.138***	.211***	.133***	.209***
	(.023)	(.013)	(.044)	(.014)	(.040)	(.018)
Private Insurer	.043*	.003	-.044**	-.015	-.036*	-.013
	(.022)	(.014)	(.019)	(.013)	(.019)	(.015)
Gov't Insurer	.099***	.038***	.043**	.088***	.050**	.089***
	(.035)	(.011)	(.020)	(.023)	(.021)	(.026)
Reform*Age30	.080	-.037	.052	-.089**	.117	-.063*
	(.094)	(.039)	(.136)	(.035)	(.164)	(.034)
Reform*Age40	.110	-.012	.006	-.062**	.055	-.031
	(.068)	(.031)	(.088)	(.024)	(.105)	(.020)
Reform*Age50	.050	-.014	-.055	-.061*	-.015	-.030
	(.071)	(.036)	(.114)	(.031)	(.129)	(.024)
Reform*Age60	.073	-.010	-.044	-.055*	.001	-.024
	(.073)	(.038)	(.116)	(.030)	(.118)	(.027)
Reform*Age30*Priv. Ins.	-.020	.018	-.057	.018	-.068	.028
	(.072)	(.024)	(.086)	(.028)	(.095)	(.031)
Reform*Age40*Priv .Ins.	-.031	-.016	.024	-.016	.030	-.019
	(.032)	(.015)	(.041)	(.019)	(.046)	(.017)
Reform*Age50*Priv .Ins.	.051	-.013	.078*	-.017	.096**	-.016
	(.032)	(.021)	(.046)	(.024)	(.045)	(.023)

Reform*Age60*Priv .Ins.	.018	-.024	.073	-.017	.077	-.020
	(.041)	(.018)	(.060)	(.023)	(.061)	(.022)
Reform*Age30*Gov't Ins.	-.093	-.002	-.160	.004	-.193*	.006
	(.072)	(.025)	(.118)	(.030)	(.111)	(.032)
Reform*Age40*Gov't Ins.	-.025	.005	.032	.010	.000	.012
	(.040)	(.024)	(.049)	(.022)	(.046)	(.025)
Reform*Age50*Gov't Ins.	.005	-.000	.053	.011	.062	.015
	(.022)	(.017)	(.045)	(.019)	(.047)	(.021)
Reform*Age60*Gov't Ins.	-.015	.000	.087	.009	.090	.014
	(.040)	(.030)	(.057)	(.030)	(.055)	(.031)
Constant	9.516***	10.32***	9.565***	9.683***	8.939***	9.117***
	(.108)	(.103)	(.138)	(.111)	(.107)	(.111)
J. Test Reform*Age*(Self)	.08	.61	.61	.11	.47	.42
J. Test Reform*Age*Priv.	.07	.05	.51	.68	.32	.53
J. Test Reform*Age*Gov't	.45	.99	.19	.96	.13	.95
J., Test Reform*Age*All	.003	.01	.04	.001	.05	.01
Observations	82587	642039	30466	261473	25486	230639
Number of Hospitals	1367	2200	1049	1546	816	1350

*- significant at the 10% level. **- significant at the 5% level. ***- significant at the *** level. Reform equals one if the state adopted caps on non-economic damages after 1993. Not reported are year effects, income, gender, hospital characteristics, age*insurance interactions and several other tort reforms control variables. All standard errors are clustered by states. The excluded age category is 30 to 39; the excluded insurance category is self-paid. NIS data is for years 1993-2006. Reform data is from DSTLR 3rd (CLEVER).

Table 2b: The Impact of Caps on Charges and Costs By Age And Insurance Status

	Length of Stay		Any Procedure		Number of Procedures (If Larger than Zero)		Died in Hospital	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Age40	.130***	.055***	.009	.006	.102*	.153***	.000	.006**
	(.033)	(.008)	(.017)	(.005)	(.058)	(.024)	(.005)	(.002)
Age50	.193***	.143***	.007	.003	.148**	.263***	.007	.021****
	(.024)	(.007)	(.017)	(.005)	(.063)	(.037)	(.005)	(.002)
Age60	.226***	.213***	.000	-.002	.157**	.315***	.027***	.043***
	(.028)	(.007)	(.022)	(.008)	(.060)	(.041)	(.007)	(.003)
Private Insurer	-.015	-.001	.000	.014**	.035	.059**	-.015**	-.005
	(.025)	(.013)	(.018)	(.007)	(.047)	(.027)	(.006)	(.002)
Gov't Insurer	.151***	.122***	-.001	-.016***	-.078*	.016	.001	.010**
	(.037)	(.010)	(.014)	(.003)	(.043)	(.021)	(.006)	(.004)
Reform*Age30	.108**	.028	.040	-.013	.197	-.172	.002	.007
	(.048)	(.020)	(.035)	(.010)	(.301)	(.129)	(.011)	(.005)
Reform*Age40	.050	.032*	.063**	.006	.145	-.080	-.004	.000
	(.043)	(.016)	(.030)	(.009)	(.213)	(.128)	(.004)	(.003)
Reform*Age50	.016	.032*	.060**	.010	.173	-.097	.018**	.000
	(.042)	(.018)	(.028)	(.008)	(.259)	(.109)	(.008)	(.002)
Reform*Age60	.057	.026	.078**	.013	.101	-.022	.013	-.001
	(.044)	(.018)	(.032)	(.009)	(.280)	(.134)	(.009)	(.005)
Reform*Age30*Priv. Ins.	-.043	.001	.032	.019*	.000	.038	.003	-.009**
	(.046)	(.020)	(.025)	(.011)	(.116)	(.058)	(.012)	(.004)
Reform*Age40*Priv .Ins.	-.017	-.014	.000	-.001	-.005	-.023	.008	-.003
	(.026)	(.013)	(.018)	(.006)	(.090)	(.040)	(.005)	(.003)
Reform*Age50*Priv .Ins.	.029	-.017	.004	-.003	.032	.024	-.013*	-.004**
	(.030)	(.018)	(.014)	(.005)	(.064)	(.045)	(.007)	(.001)
Reform*Age60*Priv .Ins.	-.022	-.021	-.009	-.003	.064	-.002	-.008	-.003
	(.035)	(.017)	(.021)	(.006)	(.120)	(.052)	(.010)	(.006)
Reform*Age30*Gov't Ins.	-.047	-.004	-.006	.023*	-.263	-.013	.010	.000
	(.052)	(.014)	(.029)	(.013)	(.223)	(.121)	(.014)	(.007)
Reform*Age40*Gov't Ins.	.011	.016	-.026	.008	-.076	-.033	.010	.000
	(.028)	(.018)	(.027)	(.009)	(.160)	(.099)	(.010)	(.003)
Reform*Age50*Gov't Ins.	-.020	.008	-.004	.000	.036	.046	-.015	.004

	(.028)	(.017)	(.015)	(.006)	(.083)	(.061)	(.009)	(.002)
Reform*Age60*Gov't Ins.	-.036	.010	-.032	.005	.185	-.031	-.005	.000
	(.036)	(.022)	(.023)	(.009)	(.145)	(.094)	(.009)	(.007)
Constant	.919***	1.198***	.635***	.872***	5.066***	3.440***	.017*	.029***
	(.075)	(.041)	(.063)	(.038)	(.429)	(.298)	(.008)	(.004)
J. Test Reform*Age*(Self)	.07	.40	.14	.002	.93	.0006	.07	.75
J. Test Reform*Age*Priv.	.36	.48	.71	.04	.95	.43	.11	.04
J. Test Reform*Age*Gov't	.67	.83	.62	.40	.07	.22	.15	.65
J., Test Reform*Age*All	.01	.001	.01	.003	.002	.0007	.06	.00
Observations	83725	660738	83753	661482	46236	570610	83687	661120
Number of Hospitals	1371	2226	1371	2226	995	2083	1371	2226

*- significant at the 10% level. **- significant at the 5% level. ***- significant at the *** level. Reform equals one if the state adopted caps on non-economic damages after 1993. Not reported are year effects, income, gender, hospital characteristics, age*insurance interactions and several other tort reforms control variables. All standard errors are clustered by states. The excluded age category is 30 to 39; the excluded insurance category is self-paid. NIS data is for years 1993-2006. Reform data is from DSTLR 3rd (CLEVER).