THE EFFECT OF MEDICAL MALPRACTICE LIABILITY ON PHYSICIAN SUPPLY

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Anecdotal evidence, claims by professional associations and the media have suggested that increased medical malpractice liability has caused shortages of physicians in some states. This study investigates this claim. I use long-difference and panel models to extend the current literature along a number of dimensions. I find evidence that Family/General, Hospital-Based, Medical Specialty, and Surgical Specialty physician workforces respond negatively to increases in the frequency and size of medical malpractice payments. A one-standard-deviation increase in the number of payments per physician causes a 2.2 percent decrease in physician workforce, while a one standard deviation increase in payment size decreases workforce by 1.2 percent.

I. Introduction

According to the American Medical Association (AMA) and a number of popular press outlets, the United States is currently experiencing a medical liability crisis that has been caused by increasing numbers of malpractice liability cases, coupled with larger malpractice settlements. It is suggested that this increased litigiousness has resulted in an inhospitable climate for physicians: malpractice lawsuits impose costs on physicians; thus, since physicians are now more likely to be sued for malpractice, their costs are higher. Do the higher costs incurred in high liability states lead some doctors to migrate to less litigious states?[1] Another way to consider this question is to ask whether physicians consider states' liability situations in their decisions of where to practice medicine. I find evidence that physician workforce falls in response to increased liability.

For physicians, there are two main costs of increased liability: (1) Direct costs include considerations such as higher malpractice insurance rates in the future, lost work time, and the fact that some patients would choose to avoid physicians whom have been sued for malpractice; and (2) psychic costs, which include suffering the stress of dealing with a lawsuit. Under free entry and exit, the theory of compensating wage differentials predicts that, in the long run, there will be no differences in physicians' profits across states, holding locational amenities fixed. As malpractice costs increase, firms (physicians) will exit the industry until prices increase enough to cover the increases in

[1] These issues are discussed in a number of news articles. For example: John Dorschner, "Doctors Discuss Changes to FMA" The Miami Herald (25 Aug 2007); Elizabeth Solomont, "Rising Insurance Rates Put City Doctors Out of Business" The New York Sun (6 Jul 2007); "Las Vegas Physicians Face Added Pressures in an Overstressed Healthcare System" PR Newswire US (9 Jan 2007); Editorial Staff "Not Enough Doctors" Investor's Business Daily (7 Jun 2006).

costs due to increased lawsuits. Since the opportunity cost of exiting the industry is high for physicians (equal to their foregone income), it is possible that rather than exiting the industry entirely, physicians might move to a more legally hospitable state.

In considering the research question posed above, it is important to consider cross-state differences that might affect physician supply. One of these issues is differences in state licensing requirements. The Federation of State Medical Boards[2] explains that the Tenth Amendment of the United States Constitution empowers states to protect the health and safety of their constituents. In response, all 50 states have established agencies that monitor and license physicians and other health care professionals. Licensing requirements are generally similar across states[3]. There are some inconsequential difference among states: some perform a criminal background check or, on occasion, require an in-person interview at the discretion of the board. Since there are no state-specific exams (as there are in the legal professions, for example) and licensing requirements are similar across states (the USMLE simply reports pass or fail; state licensing boards do not consider percentile rank), it is unlikely that state variations in licensing processes draw physicians into some states and away from others. However, once a physician is established in a particular state, the need to obtain a license in a new state may deter movement. Although there are no significant institutional barriers to entry for established physicians, moving across state lines will, almost always, cause a physician in private practice to lose her entire clientele. This is a concern only for physicians in private practice, since full-time hospital employees receive fixed salaries.

[2] http://www.fsmb.org/smb_overview.html (accessed October 4, 2007)

[3] Prospective licensees must have graduated from an accredited medical school, passed the (non-state-specific) United States Medical Licensing Exam (USMLE), completed post-graduate training and attend continuing medical education courses. There is also a processing fee (approximately $1,000 in total) and an application must be filled out.

The question of malpractice liability's effects on physician workforce is very important because if malpractice liability does reduce the number of physicians in a state, then it might be appropriate for state governments to enact policies that reduce the size and/or frequency of medical malpractice lawsuits in order to avoid the diminution of the physician workforce. If, however, it is not the number or size of payments that has driven physician shortages, then these policies will likely be ineffective.

The existing literature on the response of physician supply to medical malpractice liability is composed of two types of studies. Most identify the effect of liability through changes in legislation[4], while two use variables that more directly measure the liability environment[5] (the papers employing each strategy are discussed in more detail below). While the first type of research, which employs an event study strategy, finds that the enactment of measures such as damage caps results in increases in physician workforce, only one of the two papers that use the second strategy finds an effect, and this effect holds only for a specific subset of physicians, those at the beginning or end of their careers.

There are advantages and disadvantages to each of the two approaches. While the cap studies are able to take advantage of a well-defined, discrete event (the enactment of damage caps or other tort reforms), there is also a concern about policy endogeneity. For example, the AMA actively lobbies for tort reform[6] at the state level and the strength of such a lobby is probably positively related to the per capita size of a state's physician workforce. This would generate a positive bias in the coefficient of interest, since one

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[4] See Matsa (2007), Encinosa and Hellinger (2005), Klick and Stratmann (2007), Kessler, Sage and Becker (2005).
[5] See Danzon, Pauly and Kington (1990) and Baicker and Chandra (2005).
[6] See the AMA website: http://www.ama-assn.org/ama/pub/category/7861.html (accessed April 4, 2008).

would expect to observe tort reform in states with large physician workforces and, thus, stronger lobbies. The studies discussed below take measures to deal with this policy endogeneity problem.

In the studies using direct measures of liability (i.e., size and frequency of malpractice award payments), the primary concern is endogeneity of the variables of interest. For bias to occur, it would have to be the case that both the size of the physician workforce and the liability measures react to a third omitted variable. In order to avoid omitted variables bias, I control for a variety of factors that affect physician workforce, including demand for health services, desirability of location, and previous trend in workforce growth. Also, I control for any state-specific, time invariant unobservables as well as unobservable variables that affect all states in a particular year. An advantage to using direct liability measures rather than tort reform legislation involves interpretation of the estimated effects. In models where tort reform legislation is the variable of interest, the estimates give the effect of the *legislation* on workforce. How the legislation achieves the result is not entirely clear. While it is plausible to assume that tort reform reduces liability and that this reduction causes physician workforce to increase, it might also be the case that part of the effect of tort reform on physician supply works through a different channel. For example, physicians might perceive a state with damage caps as more doctor-friendly in general, or as favoring physicians over lawyers. Estimates produced by models using direct measures of liability, however, give estimates of how changes in *liability* affect workforce. While it is important to analyze whether a particular *policy* affects workforce (tort reform), it is also important to know how a more proximate variable (size and frequency of settlements) affects physician supply since policymakers are not restricted to tort reform in their efforts to maintain appropriate numbers of doctors per capita. Whether the relevant question of interest is "Does state X have noneconomic damage caps?" or "How frequently are doctors sued in state X and how big are the settlements?" is debatable. If it is the latter, then the studies using direct liability measures may be more appropriate than the event study approach.

The present paper uses direct measures of liability (size and frequency of malpractice settlement payments) and thus falls into the second category of literature. I find evidence that workforce responds to liability. My results are very similar to those presented in the event studies, but differ somewhat from the generally insignificant effects found in the other work that employs direct measures of liability. My empirical analysis improves upon the research done in the other two papers employing direct measures of liability in several ways. I use more complete data on physician workforce. Additionally, I employ both panel models and long-differences (Danzon, Pauly and Kington use a much shorter panel and Baicker and Chandra use only long-difference models). I also improve upon Baicker and Chandra's use of long-differences: Rather than using the first and last (or averages of the first three and last three) observations to calculate growth rates of the variables, I construct better, less noisy measures of long-term growth that use all data points in the sample period. Finally, I use expert opinions to allocate different allegation types to the appropriate physician categories (this is discussed in detail on pages 16-17).

The advantage of long-difference models is that they explain long-term changes using trends in the independent variables and incorporate information from the entire sample period into each observation; thus, they capture equilibrium reactions. However, using long-differences results in the loss of many data point - all years between the endpoints. This loss of information is not necessary with panel models. The disadvantage of using panel models in this context, however, is that they might place too much precision on the physician location decision process. That is, the panel models force us to specify which time period is relevant in explaining physician workforce in a particular year. Long-differences, however, explain the long-term change in workforce using the long-term changes in the independent variables. The findings in this paper that liability measures have a significant impact on physician supply are qualitatively consistent across these two complementary strategies. Both models produce results that are within the range of estimates generated by the previous event study literature.

II. Previous Literature

Four of the event studies discussed below (Matsa; Encinosa and Hellinger; and Kessler, Sage and Becker) use difference-in-differences (DD) while one (Klick and Stratmann) uses a triple-differences (DDD) design. The DD studies use the physician workforces in states that never have caps during the sample period as a control group for the workforces in states that do pass cap legislation over the sample period. The results from the DD estimates can be interpreted causally as long as the (regression adjusted) workforces of the two groups behave similarly before the introduction of the caps. Stated differently, there must be no omitted variables that are correlated with both workforce growth and the passage of cap legislation (i.e., passage of tort reform must not be endogenous). The DDD study improves upon the DD investigations by using low-risk specialty workforces as a control for high-risk specialty workforces within the same state.

This technique relaxes the DD assumption that the trajectories of workforces across states must be the same.

Matsa (2007) uses a difference-in-differences strategy and employs state- and county-level data to estimate the effect of damage caps on physician workforce from 1970-2000. He finds that caps increase the workforce of specialist physicians in rural (but not more densely-populated) areas by more than 10 percent. Similarly, Encinosa and Hellinger (2005) employ difference-in-differences and use county-level data from 1985-2000. The authors find that noneconomic damage caps increase counties' per capita physician workforce by approximately 2.2. The effect is stronger for rural counties (3.2 percent). Additionally, Kessler, Sage and Becker (2005) use difference-in-differences and state-level data from 1985-2001. They group tort reforms into direct (those affecting how much a defendant will have to pay in the event of a judgment) and indirect (affecting whom and when a plaintiff can sue) measures. The authors find that direct reforms increase physician supply per capita by approximately 3 percent. Klick and Stratmann (2005) combine a difference-in-differences approach with instrumental variables designed to remove the possibility of policy endogeneity. The IV results suggest that, after removing policy endogeneity, the noneconomic damage cap is the only tort reform that has a statistically significant impact on physician workforce per capita. The IV results suggest that caps increase physician workforce by between 10 and 37 percent, depending on the specification. This is much stronger than the non-IV effect, which is around 2 percent. Klick and Stratmann's (2007) later paper uses a triple differences design and state-level data from 1980 through 2001 to estimate the effect of tort reform on physician supply. The authors assume that high-risk specialty physicians are treated while low-risk specialties form a contemporaneous within-state control group. The authors find that noneconomic damage caps increase the number of physicians per capita by 6 to 7 percent, with the effect concentrated among the riskiest specialties. Taken together, the event study research provides evidence that tort reform, particularly caps on noneconomic damages, tend to increase physician supply.

Two papers use direct measures of malpractice liability to examine the effect of lawsuits on physician workforce. Danzon, Pauly and Kington (1990) estimate the effects of the malpractice environment on physicians' fees and workforce using state-level data on claim frequency, average claim size and the malpractice insurance rate charged by the state's largest insurer from 1976, 1978 and 1983. They find that physicians' net incomes do not suffer as a result of increased liability; rather, doctors increase their fees by more than enough to offset higher liability costs. The authors do not find evidence that physician workforce is affected by changes in the liability environment.

Baicker and Chandra (2005), henceforth BC, test the hypothesis that higher levels of malpractice liability decrease the physician workforce by using a long-run growth approach. BC use the change in the natural logarithms of all variables from 1993 to 2001; thus, their specification uses eight-year growth rates. To calculate the growth rates of their variables over the time period, BC use the change in the natural logs of the variables. For the liability measures, they calculate differences based on three-year averages for 1992-1994 and 2000-2002. For physician workforce growth rates, they use data from 1993 and 2001, where the 1993 data is interpolated using 1989 and 1995 observations. Because the variables are differenced, this long-difference estimation approach is robust to time-invariant state-level unobservables that might otherwise bias coefficient estimates. The evidence in their paper suggests that the workforces of physicians younger than 35 and older than 55 react negatively to increased frequency of payments. The negative effect is also present for older internists and younger obstetrician-gynecologists. When physicians of all ages are grouped together, however, there is no statistically significant effect of liability on workforce per capita. Also, the null hypothesis that all coefficients in the models are jointly zero could not be rejected.

III. Empirical Approach

A. Long-Difference Specifications

As I note above, the previous literature has used growth rates calculated by differencing the natural logarithms of the first and last observations (or two- or three-year averages at each endpoint) of the stock variables. Figures 1A-1E plot the natural logarithms of the mean and median payment size for all physicians involved in patient care in the five states with the largest populations in 2004 (these plots are typical of most states; other graphs are available upon request). From the plot, it is apparent that the conventional differencing strategy can introduce noise into the growth rate variables (i.e., simply subtracting the first value from the last value could produce a misleading growth rate). Also, long-differences produced by subtracting endpoints are not robust to changes in the sample period. In order to remedy this problem, for all variables in the long-difference specifications, I use the slope parameter of a regression of the natural log of the variable on year. This strategy uses all years of data to calculate the average annual growth rate over the sample period, rather than just depending upon the endpoints for an accurate depiction of the growth rate of the variable.

I first estimate the following model:

$$\Delta\log(MDs)_i = \beta_0 + \beta_1{*}\Delta\log(\#\ payments/MD)_i + \beta_2{*}\Delta\log(payment\ size)_i$$
$$+ \beta_3{*}\Delta\log(neighbor\ \#\ payments/MD)_i + \beta_4{*}\Delta\log(neighbor\ payment\ size)_i$$
$$+ \beta_5{*}\Delta\log(income)_i + \beta_6{*}\Delta\log(elderly)_i + \beta_7{*}\Delta\log(population)_i$$
$$+\beta_8{*}\Delta\log(insured)_i + \beta_9{*}\Delta\log(HMO)_i + \beta_{10}{*}\Delta\log(pupil/teacher)_i$$
$$+\beta_{11}{*}\Delta\log(prior\ physician\ workforce)_i + \varepsilon_i \qquad (1)$$

where *# payments/MD* is the number of settlement payments per physician, *payment size* is either mean or median malpractice payment size, *neighbor # payments/MD* is the number of payments per physician for the composite neighbor of state *i, neighbor payment size* is the mean or median payment size for the composite neighbor of state *i*, *income* is real per capita personal income, *elderly* is the proportion of the state population 65 years of age or older, *population* is lagged[7] total population, *insured* is the proportion of individuals in the state who have private health insurance, *HMO* is the HMO penetration rate, *pupil/teacher* is the pupil-teacher ratio, and *prior physician workforce* is the extrapolated value for *MDs* based upon data from 1978, 1985 and 1991 (so that Δlog(*prior physician workforce*) is the growth rate of *MDs* based upon 1978, 1985, and 1991 data).

I expect the variables capturing a state's malpractice liability environment (*# payments/MD* and *payment size*) to have negative coefficients, since theory suggests that some physicians would flee the state in response to an increase in malpractice litigation and awards. These are the primary hypotheses of this paper.

[7] Population is lagged to avoid endogeneity concerns. The rationale for having population in the model is discussed later.

The composite neighbor variables are defined as population-weighted averages of state *i*'s contiguous neighbors' payments per physician and payment sizes. Physicians are likely to consider neighboring states in their decisions of where to practice. Thus, it is important that the neighbor variables be included in the model. The hypothesized signs for the neighbor variables are positive: As a measure of neighbors' litigiousness decreases, the workforce in the state under study should also decrease as physicians choose to move into nearby states where they are less likely to be sued for malpractice; low liability states are thus hypothesized to "steal" physicians from nearby high liability states. However, it is possible that the neighbor variables could have negative signs. If states in the same area tend to move together in terms of liability measures, the neighbor variables could act as proxies for the number and size of payments variables; in this case, the neighbor liability variables could appear to have negative effects on physician workforce because of collinearity.[8]

Per capita income, elderly population, and proportion insured privately control for demand for medical services. I expect income to have a positive coefficient since health services are normal goods. Also, the proportion of the state population over 65 years should have a positive effect on physician workforce since older individuals consume more health services. The proportion insured privately should also have a positive coefficient since individuals with medical insurance will likely demand more medical

[8] There is some evidence that collinearity exists: the correlation between state *i*'s payments per physician and *i*'s composite neighbor's payments per physician is 0.6143; the analogous correlations for mean and median size of payments are 0.2273 and 0.4120. These correlation coefficients are 60 to 90 percent larger than the correlations produced when state *i* is randomly matched (within years and physician types) with some composite neighbor; the correlation coefficients produced by random matching are 0.3850, 0.1241 and 0.2163 for number of payment, mean size and median size, respectively.

services than those without insurance. I expect the pupil-teacher ratio to have a negative effect on physician workforce since an increase in the ratio signals lower school quality, and physicians are likely to consider school quality in deciding where to settle. The lagged state population is included in the model because physicians will likely respond to population change with a lag. I expect the HMO penetration rate to have a negative sign since higher HMO penetration may be associated with reduced workforce for some physician categories (Escarce et al. 1999). The prior physician growth variable is designed to control for the pre-existing trend in physician workforce growth.

Because of data constraints, I am not able to include the load factor (which is equal to malpractice premium divided by payouts by malpractice insurance companies). This variable serves to relate total payments by insurance companies to insurance premiums. The omission of the load factor is likely not very serious since the main component of other income for insurance companies is investment income, which is derived from investing premiums in (mostly) conservative financial instruments. Since all insurance companies, regardless of where in the United States they operate, invest in the same financial market, the time dummy variables I use in the panel specifications control for common shocks to investment income and thus help to control for changes in insurance premiums. Similarly, in the long-difference specifications, these state-invariant shocks are captured by the constant term. Consistent with this explanation, Baicker and Chandra found that the load factor coefficient was not statistically significant.

Equation (1) is estimated separately for each of the six physician workforce categories. In addition to estimating separate regressions for each physician type, I also "stack" the data, which produces five observations (one for each included physician category) per state per year[9]. I use this data structure to estimate a version of equation (1), which also includes dummy variables for physician category and interactions of physician category with the liability variables. Analogous to the "unstacked" model, the stacked long-difference model is robust to state and physician type time-invariant unobservables.

B. Panel Specifications

The data set I use in this paper enables me to use panel as well as long-difference specifications. The physician workforce data are available for all states in all years from 1992-2004, except for 1994.[10] I estimate the model:

$$
\begin{aligned}
MDs_{it} = {} & \beta_i + \beta_t + \beta_1 * (\#\ payments/MD)_{it} + \beta_2 * payment\ size_{it} \\
& + \beta_3 * (neighbor\ \#\ payments/MD)_{it} + \beta_4 * neighbor\ payment\ size_{it} + \beta_5 * income_{it} \\
& + \beta_6 * elderly_{it} + \beta_7 * population_{it-1} + \beta_8 * insured_{it} + \beta_9 * HMO_{it} + \beta_{10} * (pupil/teacher)_{it} \\
& + \beta_{11} * (prior\ physician\ workforce)_{it} + \varepsilon_{it} \qquad (2)
\end{aligned}
$$

where β_i and β_t are state and year fixed-effects, respectively, and the other variables are defined as before, for state *i* and year *t*. Standard errors are clustered by state to control for correlation in error terms within states over time.

Similar to the long-difference models, in addition to estimating equation (2) separately for the six physician workforce categories, I also stack the panel data so that five different physician categories are observed in each year, in each state (again, Total physician workforce is excluded since it equals the sum of the other five categories). I

[9] I exclude total physicians in patient care because these workforce data are equal to the sum of the other five categories.
[10] The results presented are based on data for which 1994 workforce was linearly interpolated, but non-interpolated results are very similar.

then estimate equation (2) with state-specialty fixed-effects rather than state fixed-effects. In the stacked model, standard errors are clustered by state-specialty.

IV. Data

All data are state-level and cover the period 1993-2004.

A. Physician Workforce

Physician workforce data were collected from the American Medical Association's Physician Characteristics and Distribution in the US. According to the AMA website, this source

> "is the most accurate and complete source for statistical data about the physician supply in the United States...All data are derived from the American Medical Association Physician Masterfile, which obtains data from primary sources only. Primary sources include medical schools, hospitals, medical societies, the National Board of Medical Examiners, state licensing agencies and many others. The stringent verification process is unique and one of the most thorough in the industry." [11]

The AMA tracks physician movement both through physicians' reporting their new addresses as well as through the postal service's address correction system. Many authors, including Baicker and Chandra, have used workforce data are from the Area Resource File (ARF), which is also derived from the AMA's physician Masterfile, but is missing several years of data.

The physician workforce categories I use in this paper are (1) Total physicians in patient care (this category includes office- and hospital-based physicians, but not those exclusively involved in administration, teaching or research), (2) Family/General practice (including family and general practitioners, geriatricians and sports physicians), (3) Medical Specialties (including allergy and immunology, cardiovascular disease,

[11] https://catalog.ama-assn.org/Catalog/product/product_detail.jsp?productId=prod240177?checkXwho=done (accessed 10 September 2007)

dermatology, gastroenterology, internal medicine, pediatrics, pediatric cardiology, and pulmonary disease), (4) Surgical Specialties (colon/rectal surgery, general surgery, neurological surgery, obstetrics/gynecology, ophthalmology, orthopedic surgery, otolaryngology, plastic surgery, thoracic surgery, and urological surgery), (5) Other Specialties (aerospace medicine, anesthesiology, child psychiatry, diagnostic radiology, emergency medicine, forensic pathology, general preventive medicine, medical genetics, neurology, nuclear medicine, occupational medicine, psychiatry, public health, physical medicine and rehabilitation, anatomic/clinical pathology, radiology, radiation oncology, other unspecified categories), and (6) Hospital-Based physicians (physicians in residency training (including clinical fellows) and full-time members of hospital staff).

Physician workforce per capita is equal to the AMA physician supply figures divided by state population, which is reported by the U.S. Census Bureau. Descriptive statistics for the physician workforce data are presented in Table 1. The physician workforce per capita grew over the sample period for all physician categories.

B. Malpractice Payments

Malpractice payment data are taken from the National Practitioner Data Bank (NPDB) Public Use File. The NPDB contains data on all disclosable reports regarding malpractice payments and adverse actions (e.g., loss of clinical privileges, professional association membership revocation) against licensed physicians, dentists, and other health care professionals. One criticism of the NPDB is that malpractice settlements that include the dismissal by a hospital or other corporation of at least one health care provider need not be reported. Nevertheless, the NPDB is the most comprehensive database of medical malpractice actions and enables researchers to construct measures of liability at the state level. The version (June 2007) of the NPDB public use file I use in the present study reports information on 419,660 malpractice cases from September 1, 1990 through June 30, 2007. I keep observations associated with medical doctors (MDs) and doctors of osteopathic medicine (DOs) (i.e., settlements involving only nurses, psychologists, pharmacists, and other health care professions are dropped). Also, in order to use the contiguous composite neighbor variables, I limit the sample to the continental 48 states. If a payment is listed as covering more than one physician, the average payment is used for that record.

The NPDB does not report the specialty of the physician on whose behalf a malpractice payment was made. That is, it is impossible to know, for example, whether a particular settlement was the result of a lawsuit against a surgeon, psychiatrist, internist, etc. However, the NPDB does report the nature of the allegation. Malpractice payments are categorized into eleven possible allegation natures: Diagnosis Related, Anesthesia Related, Surgery Related, Medication Related, IV & Blood Products Related, Obstetrics Related, Treatment Related, Monitoring Related, Equipment/Product Related, Other Miscellaneous, and Behavioral Health Related. Rather than attempt to allocate these types of allegations to the six physician workforce categories, I administered a short questionnaire to 22 physicians. The questionnaire is displayed in Appendix A. All respondents are attending physicians, and their mean number of years since graduation from medical school is 21.4 years. Respondents matched the eleven allegation natures to each of the physician workforce categories according to what types of allegations they thought were most likely to be leveled against a particular physician type. I then ranked the allegation natures by the frequency with which they were chosen for a particular physician category, and then I allocated the most popular allegation natures accounting for 75 percent of responses to each physician type. For example, if the four top-ranking allegation natures *a*, *b*, *c* and *d* were matched with hospital-based practitioners by all 22 physicians surveyed (thus accounting for 88 responses), and if there were 118 total responses for hospital-based physicians (so that allegations *a*, *b*, *c* and *d* accounted for 88/118 = 74.5% of responses), then I would allocate only allegations *a*, *b*, *c* and *d* to hospital based-practitioners. The allocations produced by this method are listed in Appendix B. Although it would be ideal to match the frequency and size of lawsuits to each particular physician type, data constraints make this impossible. The advantage of surveying physicians is that I am not arbitrarily allocating liability measures to physician types. Summary statistics for malpractice payments are displayed in Table 1. While the frequency of malpractice payments generally declined over the sample period (except for the category of Other Specialists), the size of payments, as measured by both the mean and median, grew. It is clear that the distribution of payment size is skewed since the median payment is always less than the mean. On the one hand, this might suggest that the median is a better measure of payment size since it is less noisy. However, it is also plausible that physicians' decisions are particularly affected by large payments (those that skew the payment distribution), since those are the payments that are most likely to gain notoriety. I adjust all payments for inflation using the personal consumption expenditures deflator, published by the Bureau of Economic Analysis.

C. Other Covariates

The HMO penetration rate was calculated using data from the Centers for Medicare and Medicaid Services (CMS). Following Laurence Baker (1997), I proxy for

HMO penetration rate using the penetration rate from the Medicare Advantage Program, where enrollees are members of "Medicare HMOs." Data on actual market share of HMOs is very limited, and Baker shows that the Medicare HMO penetration rate is correlated with the overall market penetration rate, and serves as a sufficient proxy for HMO activity.

Per capita income is available from the Bureau of Economic Analysis, the proportion of the state population aged 65 or over, and the proportion of the state population insured privately are available from the Bureau of the Census, and the pupil-teacher ratio is available from the National Center for Education Statistics (NCES) Common Core of Data.

V. Results

A. Long-Difference Specifications

I investigate the effect of malpractice liability on physician supply using the models and data described above. The results for equation (2) are presented in Tables 2 and 3; a summary of the magnitudes of the statistically significant effects for the variables of interest is presented in Table 8, Panel A. The joint hypothesis that all coefficients are not statistically distinguishable from zero is rejected for all regressions other than for one Medical Specialties regression (see Table 2). Also, the models presented here explain the data well relative to models estimated in previous research: the null hypothesis that all coefficients were equal to zero could not be rejected in the models estimated by Baicker and Chandra.

The frequency of malpractice payments has a statistically significantly negative effect on the Family/General and Hospital-Based workforces in both the mean and median specifications. Also, the coefficient for mean size of payments is marginally statistically significantly (p=.1051) negative for the Family/General practitioner workforce and the median size has a negative effect on Medical Specialist workforce. The results for the long-difference model in which the data are stacked are presented in Table 4. The number of malpractice payments per physician has a negative effect on physician workforce for both the excluded category of Family/General and Hospital-Based physicians. Also, median payment size negatively affects Medical Specialist workforce. The coefficients from the long-differences models presented above imply that a one standard deviation increase in the number of payments per physicians causes a decrease of 3.2% to 4.2% (depending on the physician category and specification) in the 2004 workforce; also, a one standard deviation increase in the size of malpractice payments causes a decrease of 1.6% to 2.7% in the physician workforce. The evidence presented above contrasts with previous findings by Danzon, Pauly and Kington, where neither the frequency nor the size of payments had an effect on the physician workforce. Also, Baicker and Chandra only find evidence that the liability variables affect the workforces of physicians who are younger than 35 or older than 55. My results, however, are consistent with the event studies, which use tort reform legislation to explain physician workforce.

In addition to the primary explanatory variables of interest discussed above, a number of other covariates were statistically significant with the expected signs. Proportion of the population aged 65 or older and income per capita have positive effects on physician workforce in several regressions, and the coefficient for the pupil-teacher ratio is significantly negative in two models. Two counterintuitive results are observed:

The coefficient for the proportion of the state population insured privately is consistently negative, and the HMO penetration rate has a positive effect on workforce in two Medical Specialty models.

B. Panel Specifications

I further investigate the research questions using panel specifications, which increase the sample size by twelve fold and produce more precise estimates. Tables 5 and 6 display panel results from estimating equation (3) and a summary of the magnitudes of the statistically significant effects is presented in Table 8, Panel B[12]. All regressions are highly statistically significant, and the joint hypothesis that all coefficients are zero is rejected for all panel models. As in the long-differences model, the frequency of malpractice payments has a negative effect on the Family/General and Hospital-Based physician workforces in both the mean and median specifications. Also, both the mean and median payment sizes have negative effects on the Surgical Specialist workforce, and the median payment size has a negative effect on the Hospital-Based workforce. Table 7 displays results from the models where the data are stacked. For both the mean and median specifications, payment frequency has a negative effect on Medical Specialist and Hospital-Based workforces. Also, the mean and median of payment size negatively affect Surgical Specialty and Hospital-Based workforces while only the median payment size has a negative effect on Family/General Physician workforce. Surprisingly, the size of malpractice payments has an estimated *positive* effect on the number of Medical Specialists per capita. The point estimates from the panel models presented above imply that a one standard deviation increase in the number of lawsuits per physician causes a

[12] The relevant comparisons for the magnitudes of the long-difference and panel specifications are displayed in Table 8.

decrease of 0.4% to 1.2% in the 2004 physician workforce per capita; also, a one standard deviation increase in the size of malpractice payments causes a decrease of 0.4% to 1.8% in the 2004 workforce. These effects are smaller than those produced by the long-difference models.

As in the case of the long-difference models, a number of other covariates are statistically significant. Again, as predicted, the coefficients for proportion of the population over 65 and income per capita are frequently positive, and the effect of pupil-teacher ratio is negative in two models. Again, the puzzling results that the coefficient for the proportion privately insured is negative, and that the coefficient for the HMO penetration rate is positive for two Medical Specialist regressions are present.

The larger sample size in the panel models also enables more precise coefficient estimates for the composite neighbor variables. The coefficient for the neighbor's number of malpractice payments is negative for Family/General Practitioners in both the mean and median non-stacked specifications. Also, there is evidence from the stacked models that the neighbor's payment frequency negatively impacts Medical Specialist, Other Specialist, and Hospital-Based workforces. The negative signs on the neighbor variables run counter to the hypothesized signs; this inconsistency may be due to high correlation in the neighbor and own-state liability variables.

VI. Conclusion

This paper tests the hypothesis that higher malpractice liability costs negatively affect the size of the physician workforce. I have presented evidence suggesting that this hypothesis is true. In a variety of specifications, including long-differences and panel models with fixed-effects, both of which include variables to control for pre-existing trends in the growth of the physician workforce in each state, the frequency and size of malpractice award payments have negative effects on physician workforce per capita. Estimates suggest that an increase of one standard deviation in the number of payments per physician causes a decrease in the physician workforce of 0.4 to 4.2 percent (with a mean of 2.2 percent), depending on the physician category and the model's specification; a one standard deviation increase in the size of malpractice payments causes a drop in the physician workforce per capita of 0.4 to 2.7 percent (with a mean of 1.23 percent). These results apply to four of the six physician categories examined here: Family/General Practitioners, Hospital-Based Physicians, Medical Specialists, and Surgical Specialists. The evidence in this paper is similar to that produced by a number of studies using tort reform legislation as the variable of interest, but differs from the two previous studies that use direct measures of malpractice liability.

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Figure 1A.

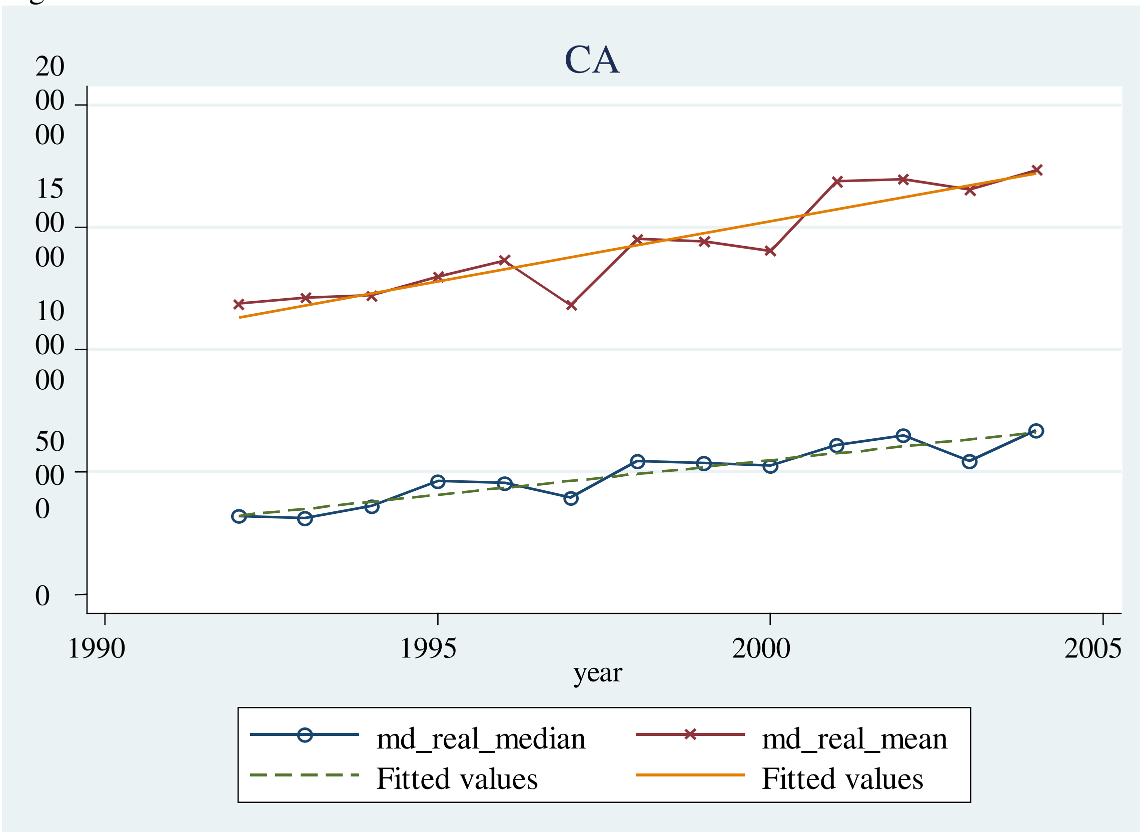
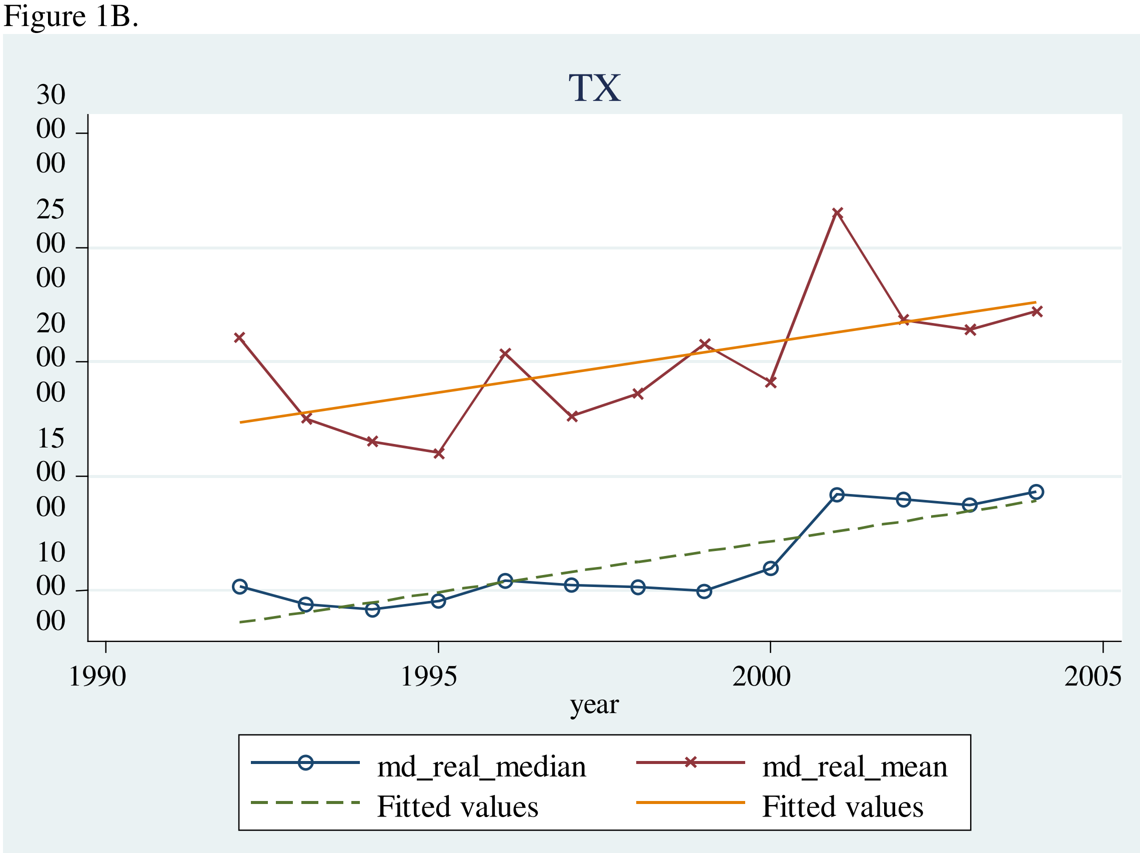


Figure 1B.



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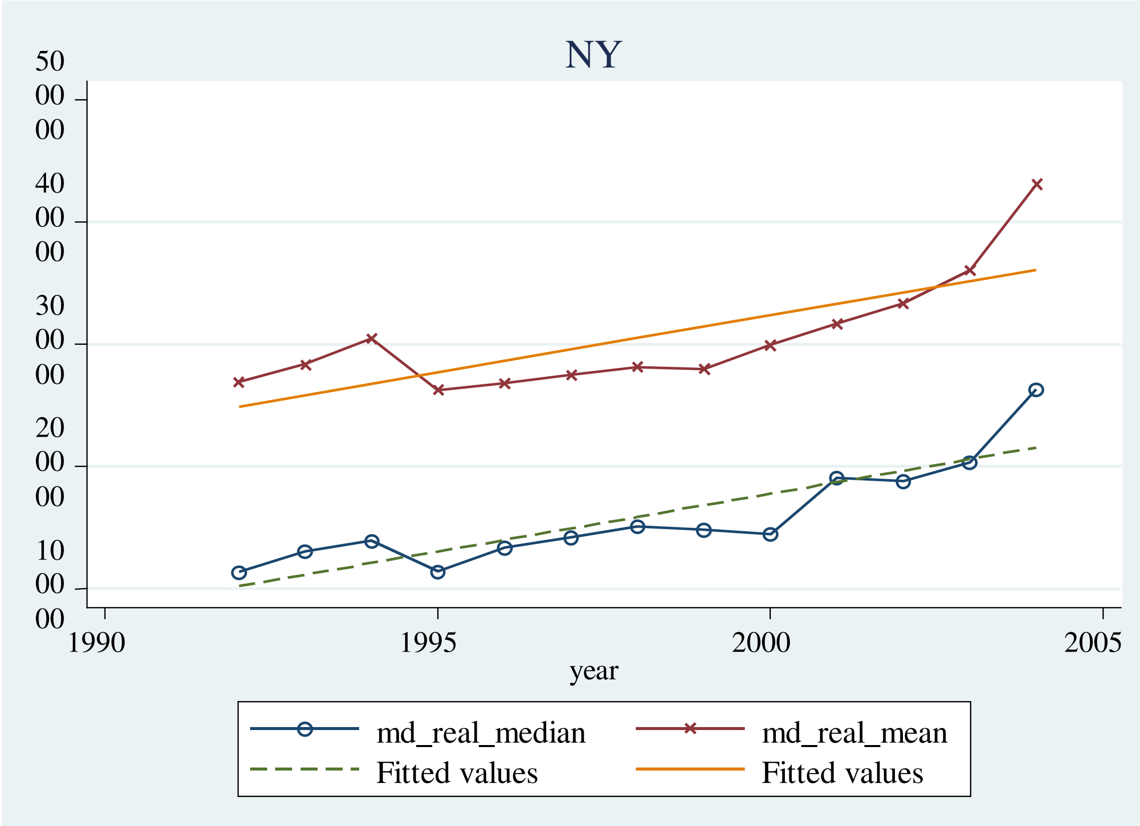

Figure 1D.

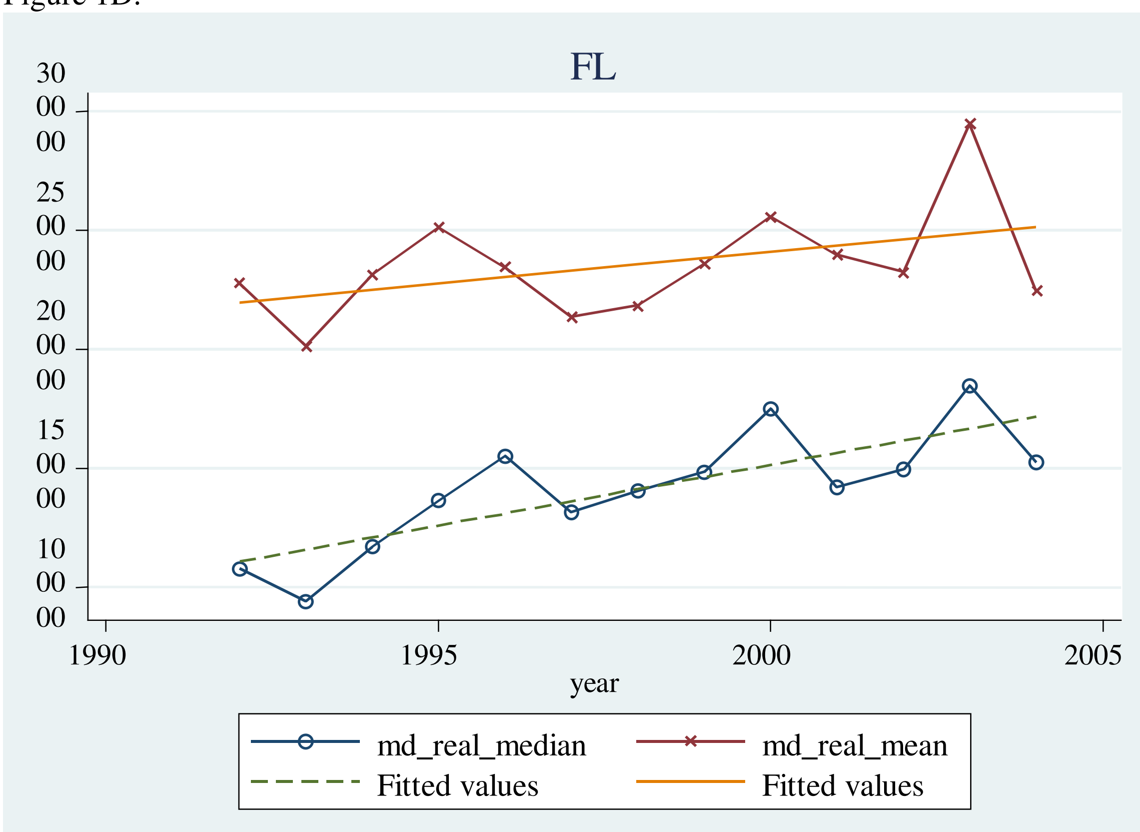

Figure 1E.

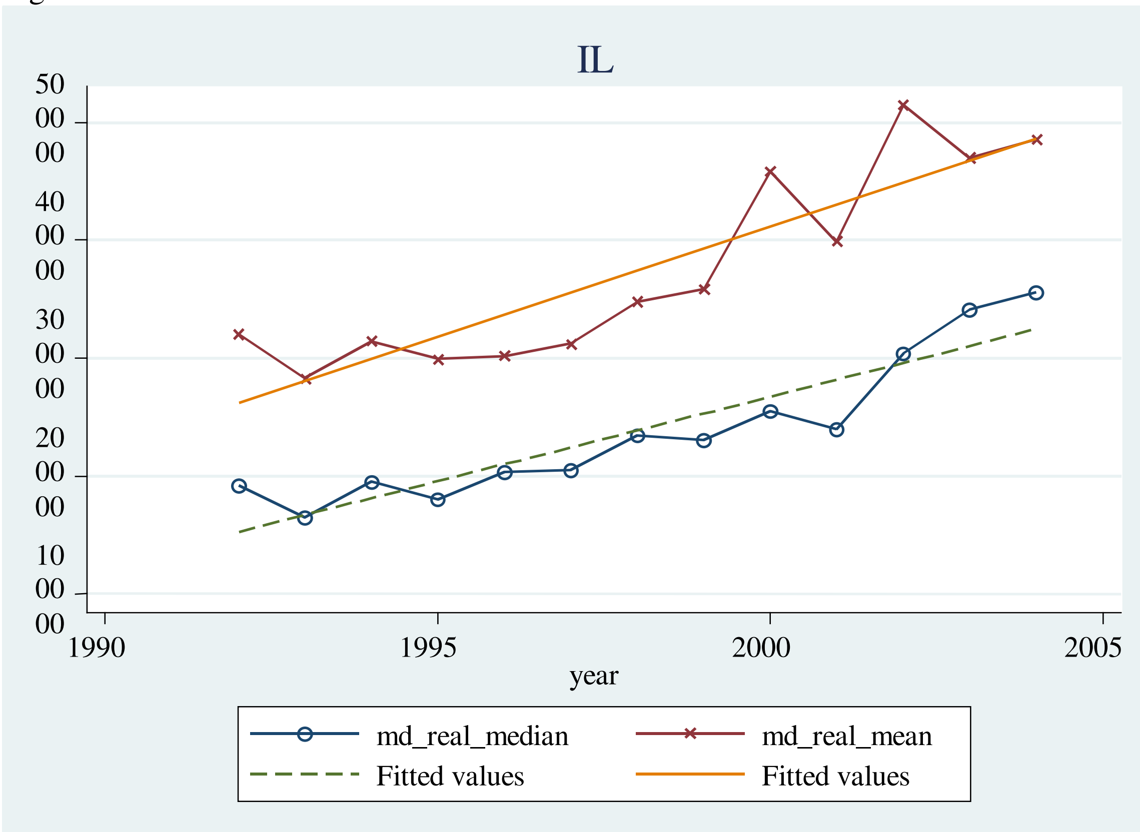
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Table 1: Descriptive Statistics					
	1992 level				Growth Rate*,
	mean	std. dev.	min	max	1992-2004
Workforce per 10,000 population					
Total	19.0	4.3	12.4	31.3	17.7
Family/General Practice	2.4	0.7	1.3	3.8	14.2
Medical Specialties	4.5	1.5	2.4	8.4	34.4
Surgical Specialists	4.0	0.6	3.0	5.4	6.9
Other Specialists	3.7	0.8	2.2	6.0	20.0
Hospital-based Physicians	4.4	2.2	1.0	11.3	9.4
Number of payments per 100 physicians					
Total	2.5	1.0	0.7	5.4	-21.9
Family/General Practice	12.8	9.1	1.9	44.1	-15.2
Medical Specialties	6.2	3.0	1.0	16.5	-35.4
Surgical Specialists	10.6	4.6	2.5	26.2	-10.9
Other Specialists	13.0	5.5	4.0	29.8	30.3
Hospital-based Physicians	12.4	9.3	3.0	62.0	-24.2
Average payment size (real dollars)					
Total	194020	79034	65404	425332	38.3
Family/General Practice	195941	78938	69565	402254	32.1
Medical Specialties	195941	78938	69565	402254	32.1
Surgical Specialists	180923	71273	65122	376379	37.5
Other Specialists	194020	79034	65404	425332	38.3
Hospital-based Physicians	192371	77371	68097	431516	37.1
Median payment size (real dollars)					
Total	80340	34862	26223	192307	65.3
Family/General Practice	85348	40594	32051	227272	57.2
Medical Specialties	85348	40594	32051	227272	57.2
Surgical Specialists	73997	32024	17482	168997	65.5
Other Specialists	80340	34862	26223	192307	65.3
Hospital-based Physicians	81585	36107	26223	203962	65.3

*These growth rates are equal to the growth rates from the regressions of the natural logarithm of each variable on year multiplied by 12, since there are 12 years in the sample.

Table 2: Long-Differences, Mean Payment Size

	Total	Family/General	Medical Specialties	Surgical Specialties	Other Specialties	Hospital-Based
# of payments	0.0163	-0.0927	0.0051	0.0263	0.0117	-0.1245
	(0.6551)	(0.0024)	(0.8971)	(0.5667)	(0.7759)	(0.0801)
payment size	-0.0108	-0.0558	-0.0227	-0.0227	-0.0057	0.0378
	(0.7608)	(0.1051)	(0.5874)	(0.5883)	(0.8847)	(0.6415)
Neighbor	-0.077	-0.0637	-0.0356	-0.0436	-0.0752	-0.0007
# of payments	(0.2326)	(0.2049)	(0.6251)	(0.5755)	(0.3121)	(0.9951)
Neighbor	-0.064	-0.0748	-0.0699	0.0116	-0.0684	-0.04
payment size	(0.4382)	(0.2878)	(0.4199)	(0.8992)	(0.4649)	(0.8211)
Proportion	-0.594	-0.5217	-0.281	-0.5788	-0.6726	-0.8822
insured	(0.0235)	(0.0462)	(0.3692)	(0.0741)	(0.0218)	(0.1173)
HMO	0.014	0.0058	0.0256	0.0174	0.0117	0.0185
penetration	(0.1773)	(0.5850)	(0.0553)	(0.1827)	(0.3106)	(0.3952)
Proportion	0.4718	0.398	0.5238	0.3643	0.3226	0.9345
over 65	(0.0679)	(0.1206)	(0.0959)	(0.2525)	(0.2565)	(0.0883)
Income per	0.4192	0.2593	0.0699	0.8616	0.4259	0.2346
capita	(0.1820)	(0.3923)	(0.8557)	(0.0314)	(0.2213)	(0.7257)
Population	-0.0753	-0.0496	-0.0157	-0.2203	-0.179	-0.1596
	(0.4866)	(0.6556)	(0.9078)	(0.1112)	(0.1435)	(0.4869)
Pupil-teacher	-0.1706	-0.3591	-0.0766	-0.1059	-0.0618	-0.0249
ratio	(0.4028)	(0.0837)	(0.7580)	(0.6757)	(0.7828)	(0.9535)
Prior phys	0.0114	-0.0135	0.0112	0.0355	0.0123	0.0268
growth	(0.5215)	(0.3381)	(0.7177)	(0.1603)	(0.5177)	(0.4345)
Constant	0.0038	0.0031	0.0264	-0.0141	0.0074	0.0007
	(0.6463)	(0.6969)	(0.0157)	(0.1657)	(0.4174)	(0.9681)
Adjusted R^2	0.2657	0.4874	0.0136	0.2442	0.175	0.1632
F	2.5457	5.063	1.0591	2.3809	1.9066	1.8331
	(0.0170)	(0.0001)	(0.4192)	(0.0247)	(0.0716)	(0.0843)
N	48	48	48	48	48	48

Figures in parentheses are p-values.

Table 3: Long-Differences, Median Payment Size

	Total	Family/General	Medical Specialties	Surgical Specialties	Other Specialties	Hospital-Based
# of payments	0.0138	-0.1023	-0.0020	0.0219	0.0099	-0.1211
	(0.6992)	(0.0012)	(0.9550)	(0.6330)	(0.8077)	(0.0908)
payment size	-0.0301	-0.0260	-0.1000	0.0001	-0.0099	-0.0249
	(0.4350)	(0.4370)	(0.0099)	(0.9972)	(0.8194)	(0.7629)
Neighbor	-0.0754	-0.0640	-0.0607	-0.0444	-0.0673	-0.0123
# of payments	(0.2220)	(0.2135)	(0.3646)	(0.5607)	(0.3444)	(0.9131)
Neighbor	-0.0508	-0.0814	-0.0250	-0.0446	-0.0417	-0.0327
payment size	(0.5203)	(0.3113)	(0.7782)	(0.6323)	(0.6410)	(0.8327)
Proportion	-0.6863	-0.6023	-0.4824	-0.5932	-0.7185	-1.0245
insured	(0.0133)	(0.0328)	(0.1141)	(0.0774)	(0.0209)	(0.0913)
HMO	0.0132	0.0076	0.0232	0.0177	0.0110	0.0161
penetration	(0.2045)	(0.4790)	(0.0535)	(0.1771)	(0.3477)	(0.4629)
Proportion	0.4681	0.4157	0.3598	0.4055	0.3303	0.8850
over 65	(0.0670)	(0.1217)	(0.2216)	(0.2049)	(0.2453)	(0.1053)
Income per	0.4240	0.2786	0.1527	0.9012	0.4125	0.2491
capita	(0.1732)	(0.3687)	(0.6645)	(0.0255)	(0.2365)	(0.7128)
Population	-0.0403	-0.0448	0.1201	-0.2220	-0.1624	-0.1104
	(0.7184)	(0.7057)	(0.3614)	(0.1219)	(0.2056)	(0.6430)
Pupil-teacher	-0.1664	-0.3372	-0.1677	-0.0716	-0.0661	-0.0510
ratio	(0.4048)	(0.1086)	(0.4622)	(0.7752)	(0.7663)	(0.9049)
Prior phys growth	0.0098	-0.0123	0.0111	0.0346	0.0111	0.0245
	(0.5781)	(0.3912)	(0.6969)	(0.1735)	(0.5612)	(0.4734)
Constant	0.0052	0.0042	0.0240	-0.0127	0.0081	0.0022
	(0.5443)	(0.6223)	(0.0239)	(0.2274)	(0.3994)	(0.8979)
Adjusted R^2	0.2762	0.4686	0.1792	0.2425	0.1695	0.1601
F	2.6308	4.7680	1.9330	2.3677	1.8718	1.8147
	(.0141)	(.0002)	(.0675)	(.0254)	(.0773)	(.0878)
N	48	48	48	48	48	48

Figures in parentheses are p-values.

Table 4: Long-Differences, Stacked

	Mean	Median
# of payments	-0.1080	-0.1124
	(.0018)	(.0007)
Med spec	0.1260	0.1135
	(.0022)	(.0016)
	[.0180]	[.0011]
Surg spec	0.1237	0.1239
	(.0002)	(.0001)
	[.0157]	[.0115]
Other spec	0.1157	0.1220
	(.0004)	(.0001)
	[.0078]	[.0095]
Hosp-based	-0.0263	-0.0202
	(.6957)	(.7685)
	[-.1342]*	[-.13267]
Payment size	-0.0371	-0.0230
	(.1964)	(.4510)
Med spec	0.0008	-0.0523
	(.9866)	(.2507)
	[-.0362]	[-.0753]**
Surg spec	0.0067	0.0053
	(.8630)	(.9187)
	[-.0304]	[-.0177]
Other spec	0.0363	0.0140
	(.3010)	(.7372)
	[-.0008]	[-.0090]
Hosp-based	0.0737	0.0076
	(.2395)	(.9135)
	[.0366]	[-.0154]
Neighbor # of payments	-0.0395	-0.0397
	(.3780)	(.3784)
Med spec	0.0240	0.0010
	(.7299)	(.9888)
	[-.0155]	[-.0387]
Surg spec	-0.0135	-0.0198
	(.8039)	(.7287)
	[-.0530]	[-.0595]
Other spec	-0.0465	-0.0416
	(.4790)	(.5097)
	[-.0860]	[-.0813]
Hosp-based	0.0082	0.0014
	(.9243)	(.9873)
	[-.03125]	[-.0383]
Adjusted R^2	0.6060	0.6123
F	89.3778	90.9423
	(.0000)	(.0000)
N	240	240

	Mean	Median
Neighbor payment size	-0.0608	-0.0648
	(.3500)	(.4255)
Med spec	-0.0376	-0.0459
	(.6951)	(.6273)
	[-.0985]	[-.1107]
Surg Spec	0.0859	0.0080
	(.4826)	(.9343)
	[.0250]	[-.0569]
Other spec	0.0072	0.0247
	(.9475)	(.7892)
	[-.0537]	[-.0401]
Hosp-based	-0.0044	0.0223
	(.9773)	(.8527)
	[-.0652]	[-.0426]
Income per capita	0.3492	0.3836
	(.3210)	(.2958)
Proportion insured	-0.5795	-0.6842
	(.0088)	(.0040)
HMO penetration	0.0161	0.0150
	(.1688)	(.1726)
Proportion over 65	0.5062	0.4930
	(.0350)	(.0447)
Pupil-teacher ratio	-0.1195	-0.1233
	(.5119)	(.4831)
Med spec	0.0196	0.0223
	(.0000)	(.0001)
Surg spec	-0.0069	-0.0049
	(.0431)	(.3824)
Other spec	0.0040	0.0035
	(.2178)	(.4983)
Hosp-based	-0.0058	-0.0052
	(.1988)	(.4407)
Population	-0.1259	-0.0899
	(.2654)	(.4518)
Prior phys growth	0.0120	0.0109
	(.2625)	(.2960)
Constant	0.0032	0.0034
	(.7034)	(.7161)

Omitted variable is Family/General.
Figures in parentheses are p-values.
Indented variables are interactions with preceding main (non-indented) variable.
Figures in square brackets are the sum of the main effect and the interaction.
*, **, ***: Sum of the main effect and interaction is statistically significant at the 0.10, 0.05 and 0.01 level, respectively.

Table 5: Panel, Mean Payment Size

	Total	Family/General	Medical Specialties	Surgical Specialties	Other Specialties	Hospital-Based
# of payments	-2.93E-04	-4.26E-05	5.02E-05	-3.50E-05	-2.95E-05	-7.70E-05
	(0.7284)	(0.0028)	(0.3679)	(0.2765)	(0.3817)	(0.0158)
Payment size	-5.87E-11	2.22E-12	-9.44E-12	-2.42E-11	-1.50E-11	-8.38E-12
	(0.1306)	(0.7229)	(0.3111)	(0.0122)	(0.1762)	(0.6139)
Neighbor # of payments	7.63E-04	-8.89E-05	3.35E-04	1.30E-05	-2.66E-05	-1.10E-04
	(0.6323)	(0.0215)	(0.1274)	(0.8113)	(0.7359)	(0.3589)
Neighbor payment size	1.78E-11	-1.35E-11	-6.43E-12	-8.98E-12	1.51E-12	3.00E-11
	(0.8905)	(0.4559)	(0.7868)	(0.6994)	(0.9614)	(0.5632)
Proportion over 65	7.02E-03	1.19E-03	3.20E-04	1.51E-03	1.29E-03	2.24E-03
	(0.0353)	(0.0137)	(0.7472)	(0.0446)	(0.0824)	(0.0685)
Income per capita	9.87E-09	1.66E-09	5.79E-09	1.84E-09	3.61E-09	-2.56E-09
	(0.1089)	(0.1516)	(0.0449)	(0.3600)	(0.0076)	(0.4207)
Population	-4.73E-11	-5.67E-12	-6.59E-12	-1.22E-11	-9.39E-12	-9.94E-12
	(0.0002)	(0.0003)	(0.1096)	(0.0000)	(0.0001)	(0.0316)
Proportion insured	-2.53E-06	-6.74E-07	2.67E-07	-4.87E-07	-1.01E-06	-4.19E-07
	(0.1696)	(0.0291)	(0.6650)	(0.1068)	(0.0267)	(0.6096)
HMO penetration	4.75E-07	-5.12E-08	1.21E-06	-3.99E-07	1.14E-07	-6.79E-08
	(0.8273)	(0.7885)	(0.0624)	(0.2159)	(0.7838)	(0.9285)
Pupil-teacher ratio	-5.64E-06	-2.70E-06	-6.47E-08	-2.27E-07	7.82E-07	-3.27E-06
	(0.5608)	(0.0883)	(0.9855)	(0.8996)	(0.6708)	(0.3054)
Prior phys growth	-6.70E-03	1.96E-01	6.22E-02	9.36E-02	-1.36E-02	-2.24E-02
	(0.8694)	(0.0225)	(0.6420)	(0.1025)	(0.6108)	(0.5392)
Constant	1.33E-03	1.47E-04	2.46E-04	2.37E-04	2.57E-04	3.84E-04
	(0.0050)	(0.0360)	(0.1942)	(0.0394)	(0.0114)	(0.0578)
Adjusted R^2	0.8402	0.7421	0.9088	0.5383	0.801	0.5809
F	106.9744	24.8843	68.3948	82.9386	54.0055	39.2262
	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)
N	576	576	576	576	576	576

Figures in parentheses are p-values

Table 6: Panel, Median Payment Size

	Total	Family/General	Medical Specialties	Surgical Specialties	Other Specialties	Hospital-Based
# of payments	-1.31E-04	-4.35E-05	5.07E-05	-3.38E-05	-2.56E-05	-7.55E-05
	(0.8143)	(0.0020)	(0.3607)	(0.3054)	(0.4351)	(0.0168)
Payment size	-1.22E-10	2.26E-13	-2.59E-11	-4.08E-11	-2.41E-11	-5.80E-11
	(0.1370)	(0.9836)	(0.2919)	(0.0291)	(0.2382)	(0.0997)
Neighbor # of payments	7.10E-04	-8.93E-05	3.30E-04	1.67E-05	-3.17E-05	-1.16E-04
	(0.6419)	(0.0163)	(0.1240)	(0.7494)	(0.6731)	(0.3271)
Neighbor payment size	6.03E-11	-1.63E-11	-6.85E-12	-6.74E-11	5.47E-11	1.57E-11
	(0.8480)	(0.6639)	(0.9056)	(0.2562)	(0.3765)	(0.8845)
Proportion over 65	7.02E-03	1.18E-03	2.85E-04	1.50E-03	1.31E-03	2.17E-03
	(0.0373)	(0.0150)	(0.7720)	(0.0451)	(0.0795)	(0.0825)
Income per capita	9.92E-09	1.69E-09	5.88E-09	2.21E-09	3.37E-09	-2.30E-09
	(0.1073)	(0.1397)	(0.0427)	(0.2824)	(0.0114)	(0.4536)
Population	-4.70E-11	-5.65E-12	-6.65E-12	-1.25E-11	-9.08E-12	-1.00E-11
	(0.0001)	(0.0003)	(0.1036)	0.0000	(0.0003)	(0.0246)
Proportion insured	-2.67E-06	-6.68E-07	2.52E-07	-5.59E-07	-1.03E-06	-4.76E-07
	(0.1412)	(0.0295)	(0.6791)	(0.0519)	(0.0239)	(0.5597)
HMO penetration	4.63E-07	-5.60E-08	1.20E-06	-3.87E-07	9.30E-08	-4.23E-08
	(0.8290)	(0.7667)	(0.0623)	(0.2370)	(0.8162)	(0.9554)
Pupil-teacher ratio	-5.26E-06	-2.72E-06	-2.00E-08	-2.79E-07	9.67E-07	-3.17E-06
	(0.5782)	(0.0841)	(0.9954)	(0.8726)	(0.5975)	(0.3126)
Prior phys growth	-7.09E-03	1.98E-01	6.27E-02	8.83E-02	-1.25E-02	-2.40E-02
	(0.8612)	(0.0215)	(0.6404)	(0.1117)	(0.6438)	(0.4948)
Constant	1.33E-03	1.46E-04	2.49E-04	2.42E-04	2.50E-04	3.99E-04
	(0.0054)	(0.0398)	(0.1883)	(0.0299)	(0.0152)	(0.0461)
Adjusted R^2	0.8404	0.7415	0.909	0.5383	0.8017	0.5828
F	65.9284	22.3464	63.0203	56.7355	43.3378	38.3517
	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)
N	576	576	576	576	576	576

Figures in parentheses are p-values.

Table 7: Panel, Stacked

	Mean	Median
# of payments	-0.0000 (.4326)	-0.0000 (.1771)
Med spec	-0.0003 (.0285) [-.0003]**	-0.0001 (.1460) [-.0002]*
Surg spec	-7.87E-06 (.8671) [-.0000]	-0.0000 (.8096) [-.0000]
Other spec	-0.0000 (.2961) [-.0000]	-0.0000 (.5910) [-.0000]
Hosp-based	-0.0001 (.0102) [-.0002]***	-0.0001 (.0208) [-.0002]***
Payment size	-1.33E-11 (.3419)	-4.41E-11 (.0138)
Med spec	6.45E-11 (.0492) [5.15e-11]*	1.59E-10 (.0000) [1.14e-10]***
Surg spec	-4.78E-11 (.0170) [-6.11e-11]***	-7.75E-11 (.0100) [-1.22e-10]***
Other spec	5.84E-12 (.7343) [-7.56e-12]	1.56E-11 (.5626) [-2.88e-11]
Hosp-based	-5.19E-11 (.1453) [-6.51e-11]**	-1.11E-10 (.0305) [-1.55e-10]***
Neighbor # of payments	1.92E-06 (.9709)	-0.0000 (.7872)
Med spec	-0.0017 (.0000) [-.0017]***	-0.0009 (.0000) [-.0009]***
Surg spec	-0.0001 (.4552) [-.0001]	-0.0001 (.4261) [-.0001]
Other spec	-0.0002 (.0272) [-.0002]**	-0.0001 (.0732) [-.0002]**
Hosp-based	-0.0006 (.0001) [-.0006]***	-0.0006 (.0002) [-.0006]***

	Mean	Median
Neighbor payment size	-9.26E-11 (.0024)	-2.15E-10 (.0007)
Med spec	3.75E-10 (.0001) [2.82e-10]***	8.17E-10 (.0000) [6.01e-10]***
Surg Spec	-8.17E-11 (.0946) [-1.74e-10]***	-1.45E-10 (.0338) [-3.59e-10]***
Other spec	1.19E-10 (.0086) [2.62e-11]	2.36E-10 (.0018) [2.07e-11]
Hosp-based	-1.39E-10 (.0980) [-2.31e-10]***	-1.14E-10 (.3154) [-3.28e-10]***
Income per capita	2.97E-09 (.0546)	3.12E-09 (.0219)
Proportion insured	-2.61E-07 (.3910)	-3.24E-07 (.2801)
HMO penetration	3.50E-07 (.2583)	3.14E-07 (.2616)
Proportion over 65	0.0011 (.0261)	0.0011 (.0139)
Pupil-teacher ratio	-1.93E-06 (.1396)	-1.74E-06 (.1657)
Population	-6.87E-12 (.0044)	-7.37E-12 (.0004)
Prior phys growth	0.0972 (.0940)	0.0723 (.1571)
Constant	0.0003 (.0007)	0.0003 (.0003)
Adjusted R^2	0.6080	0.6457
F	39.96 (.0000)	28.76 (.0000)
N	2880	2880

Omitted variable is Family/General.
Figures in parentheses are p-values.
Indented variables are interactions with preceding main (non-indented) variable.
Figures in square brackets are the sum of the main effect and the interaction.
*, **, ***: Sum of the main effect and interaction is statistically significant at the 0.10, 0.05 and 0.01 level, respectively.

Table 8: Interpretation of Coefficient Magnitudes for Statistically Significant Variable of Interest			
Workforce Category	Liability Variable	Effect of a one-standard-deviation increase in the liability variable on the physician workforce per 10,000 people	Effect of a one-standard-deviation increase in the liability variable on the physician workforce per 10,000 people as percent of 2004 workforce
A. Long-Difference Specifications			
Data Not Stacked			
Family/General	Payments per physician[1]	-0.09	-3.2%
Family/General	Payments per physician[2]	-0.10	-3.5%
Hospital-Based	Payments per physician[1]	-0.19	-3.9%
Hospital-Based	Payments per physician[2]	-0.18	-3.8%
Family/General	Mean payment size	-0.04	-1.6%
Medical Specialties	Median payment size	-0.17	-2.7%
Data Stacked			
Family/General	Payments per physician[1]	-0.10	-3.7%
Family/General	Payments per physician[2]	-0.11	-3.8%
Hospital-Based	Payments per physician[1]	-0.20	-4.2%
Medical Specialties	Median payment size	-0.13	-2.1%
B. Panel Specifications			
Data not Stacked			
Family/General	Payments per physician[1]	-0.03	-1.2%
Famly/General	Payments per physician[2]	-0.03	-1.2%
Hospital-Based	Payments per physician[1]	-0.03	-0.6%
Hospital-Based	Payments per physician[2]	-0.03	-0.6%
Surgical Specialties	Mean payment size	-0.02	-0.4%
Surgical Specialties	Median payment size	-0.02	-0.5%
Hospital-Based	Median payment size	-0.03	-0.7%
Data Stacked			
Medical Specialties	Payments per physician[1]	-0.05	-0.8%
Medical Specialties	Payments per physician[2]	-0.03	-0.4%
Hospital-Based	Payments per physician[1]	-0.06	-1.2%
Hospital-Based	Payments per physician[2]	-0.06	-1.2%
Family/General	Median payment size	-0.03	-1.0%
Surgical Specialties	Mean payment size	-0.05	-1.1%
Surgical Specialties	Median payment size	-0.06	-1.5%
Hospital-Based	Mean payment size	-0.05	-1.0%
Hospital-Based	Median payment size	-0.09	-1.8%

[1] Mean payment size specification.
[2] Median payment size specification

Appendix A: Allegation Natures Questionnaire

I am investigating the effect of medical malpractice suits on physician workforce. The data I have on malpractice lawsuits only specifies the type of allegation listed in the lawsuit, but not the type of physician against whom the complaint was filed. I would like to have an idea of which allegation types are likely to apply to which types of physicians.

Please write the allegation category numbers near the physician types to which they are likely to apply. Use as many allegation categories as necessary for each physician type (e.g., the "diagnosis related" allegation category might be listed under both cardiologists and emergency physicians). You need not use all allegation types.

Thank you so much for your help!
Number of years since medical school graduation: _______
Allegation Category
1. Diagnosis Related
2. Anesthesia Related
3. Surgery Related
4. Medication Related
5. IV & Blood Products Related
6. Obstetrics Related
7. Treatment Related
8. Monitoring Related
9. Equipment/Product Related
10. Other Miscellaneous
11. Behavioral Health Related

Physician Type

Cardiologists
General surgeons
Neurological surgeons
Obstetrician-gynecologists
Emergency physicians
Family/general medicine
All medical sub-specialists
All surgical sub-specialists
Hospital-based practitioners (employed under contract with hospitals to provide direct patient care)

Appendix B: Physician Categories and Allegation Natures

Total Physicians:
All allegation natures

Family/General Practice:
Diagnosis Related
Medication Related
IV & Blood Products Related
Treatment Related
Monitoring Related
Behavioral Health Related

Medical Specialties:
Diagnosis Related
Medication Related
IV & Blood Products Related
Treatment Related
Monitoring Related
Behavioral Health Related

Surgical Specialties:
Diagnosis Related
Anesthesia Related
Surgery Related
Medication Related
IV & Blood Products Related
Treatment Related
Equipment/Product Related

Other Specialties:
All allegation natures

Hospital-Based Practitioners:
Diagnosis Related
Surgery Related
Medication Related
IV & Blood Products Related
Obstetrics Related
Treatment Related
Monitoring Related