THE EFFECT OF MEDICAL MALPRACTICE LIABILITY ON PHYSICIANS' INCOMES

JOB MARKET PAPER

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This paper presents evidence of a compensating wage differential for physicians who face more malpractice risk, which is measured by the frequency of payments per physician and the median size of those payments. I find that physicians in areas with more frequent lawsuits have incomes that are 1 to 2 percent higher. Also, larger median settlements increase incomes by 2.5 to 3 percent. In addition, there is evidence that physicians' incomes net of malpractice insurance premiums respond negatively to increases in premiums; income falls by 28 to 31 percent of the increase in premium. This result is consistent with anecdotal evidence that it is difficult for physicians to increase their fees in response to increases in overhead.

I. INTRODUCTION

By some accounts, the United States has been experiencing a medical malpractice liability crisis characterized by increasingly large (primarily non-economic) damage awards and higher medical malpractice insurance premiums.[1] These facets of the liability crisis constitute two kinds of costs that physicians face as a result of malpractice liability. Direct costs include higher insurance premiums resulting from increased liability while psychic costs result from the stress or disutility of being sued for malpractice. This study examines the effects of malpractice liability on physicians' incomes net of malpractice insurance premiums. This is an important question for a number of reasons. If higher malpractice insurance premiums have a negative effect on physicians' incomes net of premiums, then increased malpractice liability reduces the return to the many years of education required to become a physician; this will tend to reduce the physician workforce per capita and would serve to exacerbate the physician shortage to which some in the media have alluded. It might also reduce the overall quality of physicians, as more talented individuals choose other careers with higher rates of return to human capital.

In addition to examining the effect of malpractice insurance premiums on physician income, I also investigate how non-premium measures of liability (i.e., the frequency and size of malpractice awards payments) impact physicians' incomes. This is an important question since it adds to our understanding of how litigiousness affects costs in our health care system: If physicians receive a compensating differential for malpractice liability, then excessive litigation results in higher health care costs. Other studies have considered defensive medicine (where physicians supply an inefficiently

[1] See, for example, Dorschner (2007), Solomont (2007), Staff PR Newswire (2007), Editorial Staff IBD (2006).

large amount of medical services in an attempt to avoid the possibility of being sued) as one way in which excessive litigation might introduce higher costs into the health care system. For example, Kessler and McClellan (1996) as well as O'Neill and Hennesy (2005) find that liability-reducing malpractice reforms decrease health care expenditures without compromising quality of care. Also, Dubay, Kaestner and Waidmann (1999) find that increased liability risk causes defensive medicine practices in obstetrics. The present study considers another way in which malpractice liability might affect health care costs. To the extent that physicians are monetarily compensated for bearing increased liability risk, this compensation is another channel through which liability introduces costs into our health care system.

As Rosen (1986) explains, "the theory of equalizing differences refers to observed wage differentials required to equalize the total monetary and nonmonetary advantages or disadvantages among work activities." (p. 641) That is, under free entry and exit, and holding locational and employment amenities (or disamenities) fixed, there will be no differences in physicians' profits across geographical areas in the long run. If the increased risk of being sued for a larger award is a disamenity associated with practicing medicine in a particular area, then theory predicts that physicians will be compensated for bearing this risk. The evidence presented in this paper supports this hypothesis; physicians' incomes tend to be higher in labor markets (metropolitan statistical areas) with more liability risk (i.e., larger median awards and a higher number of awards per physician).

Theory also predicts that, all else equal, higher malpractice insurance rates will increase physicians' incomes *gross of malpractice premium expenses*. This

compensation will result in no differences across geographical areas in physicians' incomes *net of premiums*. Premiums are a cost to physicians and thus reduce their profits; if doctors' *gross* incomes are not higher in areas where premiums are higher, then doctors' migratory response to premiums will eventually increase *gross* wages and result in equalization of *net* wages. However, anecdotal evidence suggests that physicians' incomes *net of premiums* have suffered from higher malpractice insurance premiums since reimbursements by third-party payers are sticky.[2] This stickiness precludes physicians from increasing their fees in response to higher premiums. Krishnan (2006) quotes a Raleigh, NC physician: "It really doesn't matter what we charge; it's a matter of how much we will be reimbursed." Krishnan further explains that even as doctors' overhead increases, their "reimbursements are stagnant or getting smaller." For example, on July 15, 2008, Congress voted to halt the 10.6% cut in Medicare reimbursements that the Centers for Medicare and Medicaid Services (CMS) implemented on July 1. Medicare reimbursement policies are important since private health insurance companies tend to follow Medicare's reimbursement rates.

I find evidence that higher malpractice insurance premiums have a negative effect on physicians' net of premium incomes. However, the other malpractice liability variables I use, the frequency of lawsuits per physician and the median settlement size, which capture the uninsurable costs of being sued (e.g., disutility or negative effects on reputation), are accompanied by a positive compensating differential.

There is much empirical evidence that compensating wage differentials occur in response to factors such as weather, crime, cost of living, job- or location-related health risks, and other locational and work-related conditions. However, there is only one study

[2] See Krishnan (2006), Washburn (1998), and Appleby (2000).

examining the impact of medical malpractice liability on health professionals' incomes. Danzon, Pauly and Kington (1990), hereafter DPK, use data from 1976, 1978, and 1983 to estimate the effect of state-level average malpractice claim size, frequency of claims per physician, and malpractice insurance premium on physicians' fees per visit. In cross-sectional models where regressions for each year are run separately, malpractice insurance premium, average claim size, and frequency of claims each have a positive effect on physicians' fees per visit. In a panel model in which there are 72 observations (one for each insurance rating territory) for each of the three years of data, malpractice premium has a positive effect on fee per visit, while the other liability variables' coefficients are not statistically distinguishable from zero. The authors state that "the analysis controls for relevant market area characteristics that are expected to affect physicians' fees and incomes," (p. 125) but these variables are not specified in the paper. It appears that physician-level variables, such as experience, are not included in the models. Assuming that factors correlated with both the liability measures and physicians' fees are adequately controlled for, the cross-section and panel models suggest that physicians were able to pass on higher malpractice premium rates to patients and/or insurance companies in the form of higher fees. It is also noteworthy that the sample period employed by DPK covers a time when managed care was only beginning to take hold.[3] Fee-for-service arrangements, which were much more common over their sample period, reimburse physicians according to their costs (up to the "usual and customary" amount) and were more flexible in their payments (i.e., they reimbursed on a visit-by-visit basis, according to the physician's bill). Managed care plans generally reimburse

[3] In 1988, 73 percent of individuals covered by employee health insurance were covered under fee-for-service plans, while the remaining individuals were covered by managed care plans. In 1996, however, only 27 percent were covered by fee-for-service arrangements (Kaiser 2007).

physicians according to pre-determined fee schedules. This prospective reimbursement system employed by most managed care arrangements does not take into account cost differences (such as malpractice insurance premiums) across physicians, thus making it more difficult for physicians to increase fees in response to increases in overhead.

The present paper extends the extant literature along a number of dimensions. As mentioned earlier, there is only one study that seeks to estimate the effects of malpractice liability risk on physicians' wages. This study uses old data that pre-dates the rise of prospective payment systems. Additionally, the physician data I use enables me to control for many micro-level variables that might otherwise bias the estimated effects of the variables of interest. Also, my liability data enable me to conduct within-state analyses and to control for state-level, unobserved, time variant factors. Finally, the evidence presented in this paper provides useful policymaking information regarding the response of physicians' wages to malpractice liability.

II. EMPIRICAL MODEL

I first describe the two empirical models for which I present detailed regression results later in the paper, followed by an exploration of the sources of variation available in my data and the pros and cons of each model.

My preferred specification is a state-year fixed-effects model that controls for state-level unobservables that may change over the sample period.[4] Identification of the variables of interest (the liability measures) thus comes from inter-MSA variation within

[4] I initially estimated a model with MSA fixed-effects. However, given the shortness of the panel (four years), this model is over-parameterized. There is insufficient variation over time in the MSA-level variables to identify their effects.

state-years. Equation (1) presents this state-year fixed-effects model (standard errors are clustered by state-year)[5]:

$$\ln(Y_{izpsmt}) = \beta_1 COUNT_{zsmt} + \beta_2 MEDIAN_{zsmt} + \beta_3 PREMIUM_{zsmt} + \beta_4 INDEX_{sm} + \beta_5 X_{izsmt} + \alpha_z + \delta_p + \gamma_{st} \quad (1)$$

where the subscripts and variables are as follows (expected effect of variable, if applicable, is in parentheses):

i: individual

z: specialty, *z* = internist, general surgeon, obstetrician-gynecologist

p: practice type[6], *p* = 1, ..., 21

s: state

m: metropolitan statistical area

t: year, *t* = 1995, 1997, 1999, 2003

$\ln(Y_{izpsmt})$: natural logarithm of real annual income, net of all expenses

$COUNT_{zsmt}$: number of malpractice payments per physician in MSA (+)

$MEDIAN_{zsmt}$: real median size of malpractice payments (+)

$PREMIUM_{zsmt}$: real mean malpractice insurance premium (-)

$INDEX_{sm}$: metropolitan area wage index for physicians (+)

X_{izsmt} : vector of exogenous individual-level variables:

[5] I also estimated models using the mean payment size rather than the median. In these models, payment size was never statistically different from zero, and the median variable always produced a better fit than the mean. Median provides a measure of liability that is less skewed by large settlement payment outliers. Thus, median is the preferred method of capturing malpractice award payment size.

[6] Practice types identified by the CTS survey include Solo practice, two physician practice, group practice, group model HMO, staff model HMO, medical school/university, private hospital-owned, state/local government hospital, state/local government clinic, state/local government other, other insurance, integrated health system, free-standing clinic, physician practice management (PPM), community health center, management services organization (MSO), physician-hospital organization (PHO), locum tenens (temporary positions), independent contractor, employer-based clinic, other.

- Dummy for doctor of osteopathic (as opposed to allopathic) medicine (?)
- Dummy for graduation from a medical school outside the United States (?)
- Dummy for female (?)
- Years of experience practicing medicine (+)
- Years of experience squared (-)
- Dummy for whether the physician has passed the board exam in his/her specialty[7] (+)
- Natural logarithm of the number of weeks worked in the previous year (+)
- Natural logarithm of the number of hours spent in medically-related activities during the last complete week of work[8] (+)
- Proportions of patient care practice revenue coming from Medicare, Medicaid and managed care (-)
- Number of contracts the practice has with managed care plans (+)
- Dummy variable for salaried physicians (-)
- Dummy variable for the possibility of salary adjustments depending on the performance of the physician and/or practice (+)

α_z : specialty fixed-effect (+ for general surgeons and obstetrician-gynecologists)

δ_p : practice type fixed-effect

γ_{st} : state-year fixed effect

[7] Physicians need not be boarded to practice medicine legally. However, boarded physicians may have higher incomes, in part because a physician who is not boarded may have difficulty contracting with insurance companies.

[8] I use the natural logarithm of weeks of work and hours of work, rather than the untransformed variables, since Y = (weeks/year)*(hours/week)*(wage/hour) => ln(Y) = ln(weeks/year) + ln(hours/week) + ln(wage/hour).

As discussed in the introduction, the main variables of interest are *COUNT, MEDIAN,* and *PREMIUM*. I expect *COUNT* and *MEDIAN* to have positive coefficients, since both the frequency of malpractice payments per physician and the size of those payments are disamenities for which a physician would be compensated. I expect *PREMIUM* to have a negative effect on physician income net of premiums since reimbursements are sticky and thus physicians cannot easily increase fees in response to changes in costs.

According to the MedLinePlus Medical Encyclopedia, doctors of osteopathy (D.O.s) emphasize holistic treatment and manual manipulation of the body. There are no differences in the training of allopathic physicians (M.D.s) and D.O.s during residency, and in recent years, the philosophical and practical gaps between M.D.s and D.O.s have narrowed. The effect of being a D.O. is thus ambiguous: It is possible that patients prefer the better-known allopathic approach and the "M.D." designation, but it is also plausible that these two types of physicians are very close or even perfect substitutes. The expected sign for the coefficient on the foreign graduate dummy variable is also ambiguous: It is possible that foreign graduates have higher salaries if only the most talented foreign graduates train and become licensed in the United States. However, if patients prefer American physicians and/or perceive foreign medical schools as inferior, foreign graduates would tend to have lower incomes. The hypothesized sign for the female indicator is ambiguous; it may be zero or negative. Sasser (2005) finds that female physicians' incomes are lower because of choices (e.g., raising children) that reduce hours worked, while Hoff (2004) finds that female hospitalists are paid less than their male counterparts, despite similar work schedules. The models I estimate control for hours and weeks worked. Thus, Sasser's finding suggests that the coefficient for the

female dummy variable will be equal to zero while Hoff's evidence implies that the coefficient will be negative. The anticipated effects for proportions of practice revenue coming from Medicare, Medicaid and managed care are all negative since these third-party payers use prospective billing systems, unlike fee-for-service arrangements which tend to be more generous. After controlling for the proportion of income from managed care, I expect the number of managed care contracts to have a positive effect on income since having more managed care contracts means that the physician is a member of more approved provider networks and would thus attract more patients.[9] I expect surgeons and obstetrician-gynecologists to have higher incomes since they have longer residencies (obstetrician-gynecologists train for a minimum of 4 years after graduation from medical school; general surgeons train for 5).

In addition to the state-year fixed-effects model, I also estimate a model with state-year-specialty fixed-effects. Like the state-year model discussed above, the state-year-specialty model controls for state-level unobservables that vary over time. The advantage of the state-year-specialty model is that it allows these unobservables to differentially affect the three specialties I examine. Since the state-year-specialty model is more highly parameterized and restricts identification to within state-year-specialty cells, estimates tend to be less precise.

$$\ln(Y_{izpsmt}) = \beta_1 COUNT_{zsmt} + \beta_2 MEDIAN_{zsmt} + \beta_3 PREMIUM_{zsmt} + \beta_4 INDEX_{sm} + \beta_5 X_{izsmt} + \delta_p + \varphi_{stz} \quad (2)$$

where φ_{stz} is a state-year-specialty effect and other variables and subscripts are defined above.

[9] Without controlling for proportion of revenue from managed care, the number of managed care contracts would likely proxy for the importance of managed care to patient care revenue and thus would likely have a negative coefficient.

The data sources I employ enable me to take advantage of within-state variation in the malpractice liability measures. This is important for a number of reasons. Most obviously, there are likely state-level unobservables, which if not controlled for, might bias the coefficients of interest. Using liability measures at the metropolitan area level enables me to use state-by-year fixed-effects rather than state fixed-effects. I can thus control for state-level unobservables that *are not* time invariant. My identification therefore comes from differences within states and across MSAs in a particular year, holding any legislative, cultural, etc. variables constant. Using state-level liability variables would only allow me to control for state-level unobservables that are time-invariant and would preclude identification within state-years and across MSAs. In addition, there is substantial within-state variation in the frequency and size of malpractice settlement payments, as well as malpractice premiums. My data enable me to take advantage of this variation.

Figures 1, 2 and 3 help to demonstrate the source and importance of within-state variation. The bar labeled "Max payments per physician" ("Min payments per physician") in Figure 1 displays the four-year average number of malpractice payments per physician in the MSAs with the maximum (minimum) number of payments for each of the five states with the largest 2000 populations. The bar labeled "Mean payments per physician" uses the four-year average of the mean number of payments per physician in each state. Figures 2 and 3 do the same for median size of malpractice payments and the malpractice insurance premium, respectively. From these figures, it is evident that using state-level liability and premium data would result in the loss of important variation that could help to explain the relationship between income and malpractice liability. For

example, in Figure 1, Texas and Florida have similar levels for "Mean payments per physician," but their minimum and maximum payments per physician are quite different. Similarly, considering Texas and New York in Figure 2, using the state's average malpractice payment size would mask significant within-state variation that might otherwise be used to explain physicians' incomes. A similar phenomenon is evident in Figure 3: The average malpractice insurance premiums in New York and Florida are similar, when compared to the differences in their maximum and minimum values.

In addition to the state-year fixed-effects model, I also estimate a model where I control for state-year-physician specialty unobservables. In this model, identification comes from variation within state-year-specialty cells. This is important, for example, because in a particular year, a state's legislative environment might affect specialties differentially. For example, if a state's legislature passes a cap limiting damages, it is likely that the size and/or frequency of malpractice settlement payments on behalf of obstetrician-gynecologists will decrease by a larger amount than those of internists; this is simply because obstetrician-gynecologists generally suffer larger and more frequent malpractice awards payments than do internists. The state-year-specialty model controls for this type of unobserved effect. Figure 4A presents the average number of payments per physician in California for each sample year (Figure 4B does the same for Texas; Figures 4C through 4F do the same for settlement payment size and malpractice insurance premium, respectively). Figures 4A through 4F demonstrate that the malpractice variables do indeed behave differently for different specialties for the two largest states by 2000 population. Examining Figure 4A, California's ob-gyn payment frequency increased from 1995 to 1997, decreased from 1997 to 1999, and increased

again from 1999 to 2003. This pattern is strikingly different from those of internists and general surgeons in the same state over the same period. Internists' payment frequency decreased over each interval; surgeons' payments increased from 1995 to 1997, and then decreased for the rest of the sample period. There are also obvious differences in the size of settlement payments (Figures 4C and 4D) across the three specialties, within state-year combinations. Figures 4E and 4F illustrate that there are also differences across specialties in the behavior of malpractice insurance premiums, though they are not as pronounced as the inter-specialty differences in the other two liability measures.

As Figures 4A through 4F demonstrate, internists, general surgeons, and obstetrician-gynecologists have distinct malpractice liability experiences. This might suggest that their incomes also *respond* differently to given changes in the malpractice variables. It is for this reason that I interact the variables of interest (frequency of payments, median payment size, and malpractice insurance premium) with physician specialty. This allows the estimated coefficients to vary according to specialty.[10]

This study seeks to estimate the effect of malpractice liability on physicians' incomes. Figures 1 through 3 provide some suggestive evidence that doctors are compensated for bearing more malpractice risk. In Figure 1, the line labeled "Income in MSA with max payments per physician" ("Income in MSA with min payments per physician") plots the four-year average incomes in the MSAs with the maximum (minimum) number of payments per physician. Figures 2 and 3 do the same for the

[10] I present interacted regression results for the state-year fixed-effects model. I estimated the interacted model for the state-year-specialty fixed-effects model, but the model is too highly parameterized to detect statistically significant effects.

median size of malpractice payments and the malpractice insurance premium[11], respectively. In Figures 1 and 2, it appears that incomes in the MSAs with more liability (i.e., maximum frequency and size of payments) tend to be greater. There is no obvious pattern, however, relating income to malpractice premium. In the fixed-effects models described herein, after controlling for myriad covariates that may be correlated with both income and the variables of interest, I find that the size and frequency of lawsuits do indeed have positive effects on physicians' incomes net of premiums, while the size of the malpractice premium has a negative effect on income net of premiums.

An important identification issue to consider is the exogeneity of the variables of interest. In order for endogeneity bias to occur, it would have to be the case that both physicians' incomes and the liability measures are jointly determined or are otherwise correlated with an omitted variable. In order to avoid omitted variables bias, I control for a variety of individual- and practice-level factors that affect physician income (these variables are discussed above). Also, in my preferred specification, I include state-year fixed-effects, which control for state-level unobservables that vary over time. Thus, an omitted variable must be correlated with both physicians' incomes and the liability measures, and must vary within a state and within a year. For example, omitted variable μ would cause biased results if μ has a different effect on internists in Alabama in 1995 than on surgeons in Alabama in 1995. Bias might also occur if μ affects Birmingham, Alabama in 1995 differently from Montgomery, Alabama in 1995. In the state-year-specialty model, for omitted variable η to cause bias, it must be correlated with both physician income and the variables of interest, and η's effect must vary within a state, in

[11] The income numbers in Figure 3 are adjusted for the number and size of malpractice payments. Unadjusted income values produce a similar pattern. In Figures 1 and 2, income is not adjusted.

a particular year, in a particular specialty. For example, η's omission would result in bias if η affects Birmingham, Alabama internists in 1995 differently from Montgomery, Alabama internists in 1995.

III. DATA

The present study examines the effect of medical malpractice liability on physician income using a number of data sources. Data on physicians' incomes net of all expenses (including malpractice insurance premiums), demographics and practice characteristics are from the restricted versions of four rounds of the Community Tracking Study (CTS) Physician Survey (Center for Studying Health System Change, various years), covering the years 1995, 1997, 1999 and 2003. I eliminate any observations where it appears that the attachment to the labor force is weak. This includes observations where income is less than $10,000, weeks worked in the last year are less than 26, and hours worked in the last week are less than 20. Additionally, I eliminate observations where hours worked are greater than 84. Finally, I drop observations from the state of New Jersey since New Jersey is an outlier in terms of the difference between malpractice insurance premiums and expected malpractice payouts; results are very similar when I keep New Jersey in the sample. From Table 1, mean income of all physicians in the sample is over $200,000 (2000 dollars) with an average of 13.5 years of experience. Slightly more than half of the sample consists of salaried physicians and 19 percent of the sample's salaries are adjustable within the current contract period. Only 5 percent of the physicians are osteopathic physicians, 18 percent are foreign graduates, 17 percent are female, and 84 percent are boarded in their specialties. Physicians in solo or

group practices account for approximately two-thirds of the sample, followed by physicians employed by medical schools (10.8%), hospitals (10.3%), and HMOs (4.4%); the remainder are employed by "other." The majority of physicians in the sample are internists (68.2%), followed by general surgeons (23.8%) and obstetrician-gynecologists (8%).

Variables capturing malpractice liability come from the National Practitioner Data Bank (NPDB) and include the number of settlement payments per physician and the median size of payments. 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 recognized as one of the most comprehensive databases of medical malpractice actions and enables researchers to construct measures of liability at the state level. Because of confidentiality concerns, data at geographical units finer than the state require a special request; state-level data, however, are available in the NPDB public use file. For the purpose of this study, I obtained MSA-level data from the Division of Practitioner Data Banks at the Health Resources and Services Administration.

The NPDB does not report the type of 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. To create a means of relating allegations to physician 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 which 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. For the purpose of this study, I use only internists, surgeons and obstetrician-gynecologists because of malpractice insurance premium data constraints. 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. Applying the results of the survey to the

NPDB data produces the summary figures in Table 1. The average median malpractice payment size is over $160,000 (2000 dollars), and there are 0.22 malpractice payments per physician. Obstetrician-gynecologists tend to have the largest and most frequent malpractice settlement payments, followed by internists and general surgeons. Generally, the insurance premium (which is invested in a conservative portfolio of securities after its collection at the beginning of the policy year) is based upon the expected payout by the insurer and administrative expenses. This implies that, unless insurers' investment revenues are particularly strong, the observed malpractice insurance premium should, on average, be greater than the expected payout per physician. For all physician types together and general surgeons, this is indeed the case: For all physician specialties, the median expected payout is $16,778 and the median insurance premium is $18,813.[12] For general surgeons, expected payout is $12,479 and the premium is $26,729. However, this pattern reverses for internists and obstetrician-gynecologists: Internists' expected payout is $14,676 but their premium is only $8,046, and obstetrician-gynecologists' payout and premium are $50,827 and $41,966, respectively. The causes for this pattern may be related to the current malpractice insurance crisis, which started around 2000, that Thorpe (2004) and Mello (2006) describe. Both authors explain that insuring medical malpractice involves a large amount of uncertainty, making it difficult for actuaries to set premiums appropriately (i.e., commensurate with payouts). One reason for this uncertainty is the long "tail" inherent in medical malpractice, where the average time

[12] The premiums reported here are the median premium figures from Table 1, multiplied by 1+r, where r is equal to half the annualized yield on 6-month Treasury bills (assuming that the insurance company is able to collect interest on the premiums for half of the policy year). The interest rates are 2.795%, 2.59%, 2.38% and 0.53% for 1995, 1997, 1999, and 2003, respectively. These data are from the Economic Report of the President, Table B-73, available from http://www.gpoaccess.gov/eop/tables08.html (accessed 9/5/08).

between alleged harm and claim settlement is four to five years. This makes it difficult for insurers to accurately estimate their liability in any particular year, resulting in weak relationship between premiums and payouts. Indeed, the "statistical relationship between insurers' claim payments and malpractice premiums is *weakly* positive." (emphasis added) (Mello 2006) Also, in times of stable claims payments by insurers; it is likely that premiums would more closely track payouts. However, both Mello and Thorpe note that over my sample period, claim frequency and severity were increasing. It is possible that these changes further weakened the premium-payout relationship. Related to this uncertainty is the fact that there were lower than expected claims payments in the early-1990s. The unused reserves that insurers put aside to cover claims in these years were thus carried over into subsequent years. Since adding to reserves is an expense, and since insurers did not have to augment reserves as much in the mid- and late-1990s, profits increased. This had a slowing effect on premium increases. Another explanation for expected payouts being greater than premiums is changes in insurers' investment income over the sample period. Higher returns from the mid-1990s through 2000 had a decreasing effect on premiums, while lower returns after 2000 likely resulted in higher premiums. My sample consists of observations from four years (1995, 1997, 1999 and 2003), three of which are in the high-return period.

Physician workforce (which is used to calculate the number of lawsuits per physician) was collected from the American Medical Association's (AMA) publication, 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."

The AMA tracks physician movement both through physicians' reporting their new addresses as well as through the postal service's address correction system.

Medical malpractice insurance rates were collected from the Medical Liability Monitor (MLM). Although the MLM lists insurance rates at the county, metropolitan, or regional level within some states, much of the premium data are only available at the state level. I calculated the average premium for the insurers listed in the MLM. The MLM collects data only for internists, general surgeons, and obstetrician-gynecologists, thus limiting my sample to these specialties. The MLM reports the premium paid by a typical physician in the state or area specified. Although the large majority of the rates reported are for claims-made policies with $1 million/$3 million coverage limits, occasionally different rates are reported. For example, if the most common policy in a particular state is for $1 million/$1 million limits, the MLM reports rates for those limits. Similarly, if a state has a patient compensation fund that covers damages above a certain threshold, the MLM reports the premium for the physician's base coverage, as well as the surcharge used to pay for the compensation fund. In any case, the MLM aims to report representative malpractice insurance premiums.[13] The heterogeneity in the type of malpractice insurance coverage provided will probably not bias the results from the state-year fixed-effects model (equation (1)) nor the state-year-specialty model (equation (2)). This is because I am controlling for unobservables within each state-year combination.

[13] Estimating the models after dropping states with premiums other than for simple $1 million/$3 million claims-made coverage without a patient compensation fund reduces precision and, thus, the significance of the results.

Even if the compensation fund laws or the most common insurance coverage limits change over time, the state-year fixed-effects model will produce unbiased estimates. From Table 1, the average premium across all specialties is $24,538, with obstetrician-gynecologists having the largest average premium ($47,862), followed by general surgeons ($31,056) and internists ($9,756). An index to control for wage differences across metropolitan areas was provided by Dewey and is based upon the work by Dewey and Rojas (2008). This index improves upon existing measures of inter-city wage differentials because it accounts for the fact that occupations located in denser areas within MSAs tend to have higher wages. All data expressed in dollar amounts are deflated to 2000 dollars using the consumer price index.

IV. RESULTS

Table 2 presents regression results for estimation of equations (1) and (2). The first column displays results from the state-year fixed-effects model while the second column shows results from the state-year-specialty fixed-effects model. In both models, the estimated coefficient for the median payment size variable is positive and significant, implying that an increase of $141,545 (the standard deviation of median payment size) in the median malpractice award results in an increase in income of 2.9 percent. There is also evidence from the state-year fixed-effects model that the number of malpractice payments has a positive impact on income net of premium. A one-standard deviation increase in the number of payments per physician (0.67) increases income by 0.9 percent. Also, both models suggest that income net of premium responds negatively to premium; a one-standard deviation increase in the malpractice premium ($22,199) is associated with

a decrease in income of 3.1 percent or $6,242; thus, physicians' incomes net of premiums decrease by approximately 28 percent of the change in the premium. If incomes displayed full stickiness, then premiums would reduce net income dollar-for-dollar; if incomes were not at all sticky and adjusted perfectly, then there would be no effect of premium on income.[14] The results presented here provide evidence for the intermediate case, where physicians' net incomes are "moderately" sticky in response to changes in premiums. Perhaps stickiness is mitigated by the fact that physicians are able to forecast, to some extent, changes in premiums before the changes occur; they may be able to incorporate this information into fee negotiations with prospective payers. Also, larger physician groups and institutions such as hospitals, universities, medical schools, and managed care corporations are able to shift revenues across operations and may therefore be able to insulate their physicians' incomes from changes in overhead. Finally, there is anecdotal evidence that physicians who face especially high premiums sometimes "go bare" and choose not to buy malpractice insurance, or self-insure using bonds (see Miilee (2002), Clarke (2004), Skidmore (2002), and Boulton (2004)). Nevertheless, on average, physicians in areas with higher malpractice insurance rates tend to have lower net incomes, ceteris paribus.

Table 3 presents results for the state-year fixed-effects model (equation (1)) where the liability and malpractice insurance premium variables are interacted with physician specialty. This specification permits the effects of the variables of interest to differ

[14] In the long-run, there is evidence that physicians' incomes adjust fully to changes in the malpractice premium: In models where the premium is lagged by one (e.g., 1995 premium is used to explain 1997 income; 1997 premium explains 1999 income; and 1999 income explains 2003 income) or two periods, the coefficient for the premium is never statistically significantly negative. In fact, it is only statistically distinguishable from zero once, in the case of one lag for internists, and the coefficient is *positive*.

across specialties; the flexibility afforded by the interactions is important since different physician types face different levels of risk and may have distinct attitudes on the subject. For example, the incidence of lawsuits resulting in settlement is much higher for obstetrician-gynecologists than for the other two specialties (0.56 lawsuits per ob-gyn, compared to 0.13 for surgeons and 0.14 for internists). Perhaps riskier specialties accept the idea that being sued is something that will most likely happen sometime in the course of a career, and thus require less compensation for bearing an extra "unit" of liability risk. Figures 4A through 4F (discussed in Section III) illustrate graphically the differences in the behavior of the liability measures for each of the three physician specialties in the sample.

The excluded physician type is internist; the results presented for general surgeons and obstetrician-gynecologists equal the sum of the internist's coefficient plus the relevant specialty's estimated coefficient. For example, the figure presented for "Payments per physician (general surgeons)" in equation (1) is 0.0383, which is equal to the sum of the "Payments per physician" coefficient (0.1293) and the coefficient for number of payments per physician interacted with the general surgeon indicator when it is equal to unity (-0.0911).

The results in Table 3 show that the number of payments per physician has a positive effect on income for internists and general surgeons. An increase of 0.15 payments per internist (the standard deviation of the payments per internist variable) results in an increase in income of approximately 2 percent; the corresponding figure for general surgeons is 1.2 percent. There is also evidence that internists are compensated for bearing the risk of a larger malpractice settlement: An increase of one standard

deviation in payment size causes an increase in internists' income of 2.7 percent. The results also show that general surgeons' incomes suffer in response to increases in insurance premiums; an increase of one standard deviation in general surgeons' insurance premiums ($18,086) is associated with a 2.2 percent ($5,637) decrease in income, which is 31 percent of the change in the premium.

All of the regressions are highly significant, and many of the results for the other variables in the regressions are as predicted. Graduates of foreign medical schools earn 2-3 percent less than graduates of American schools, and female physicians earn 23 percent less than male physicians, even when I control for amount worked. Salaries peak at about 19 years of practice experience after graduation from medical school. Boarded physicians are paid a premium of approximately 12 percent while salaried physicians tend to make 5-6 percent less. The hours worked in the previous week has a positive coefficient, but the number of weeks worked in the previous year has no effect on income.[15] The proportions of patient care income derived from Medicare, Medicaid, and managed care sources negatively impact income. However, after controlling for the amount of practice income derived from managed care, the number of contracts the physician's practice has with managed care insurers has a positive effect on income. Finally, the two non-internist specialties earn more than internists; surgeons earn approximately 29 to 34 percent more, while obstetrician-gynecologists earn an extra 26 to 28 percent.

[15] Perhaps this unexpected result can be explained by the lack of variation in the weeks worked variable. This is evident in Figure 4.

V. FURTHER INVESTIGATION

In addition to the models described above, I make a number of changes to the specification and the sample to investigate the robustness of my results. Already I have shown in Table 2 that preferred state-year results are robust to the inclusion of state-year-specialty fixed-effects in addition to state-year effects.

I also estimate a state fixed-effects model in which I include separate year effects. In addition to variation within state-year and state-year-specialty cells, there is substantial variation in the variables of interest within states over time (this is evident in Figures 4A through 4F). I estimate the following state fixed-effects model to take advantage of this variation:

$$\ln(Y_{izpsmt}) = \beta_1 COUNT_{zsmt} + \beta_2 MEDIAN_{zsmt} + \beta_3 PREMIUM_{zsmt} + \mu CAP_{st} + \beta_4 INDEX_{sm} + \beta_5 X_{izsmt} + \alpha_z + \delta_p + \gamma_s + \tau_t \quad (3)$$

where CAP_{st} is an indicator variable equal to unity if state s had economic, non-economic, or total damage cap legislation in place in year t. The cap variable is an important control for a state's legislative environment vis-à-vis medical malpractice liability. I expect the coefficient on the cap variable to be negative since being protected from high malpractice settlements is an amenity for a physician. I also include year fixed-effects, τ_t, to control for unobservables affecting all physicians' incomes in all areas in a particular year. Standard errors are clustered by state. Data on economic, non-economic and total awards caps are from Piette (2007); one quarter of the states in the sample experience a change in damage cap laws over the sample period. The advantage of this model is that it allows identification of the effects of the variables of interest both over time and across MSAs in the same state, rather than just across MSAs within a state

in a particular year (as was the case with the state-year fixed-effects model). The results for the variables of interest produced by equation (3) are presented in column A of Tables 4 (non-interacted) and 5 (variables of interest interacted with physician specialty). Table 4 shows that median payment size has a positive effect on physicians' income while malpractice premium has a negative effect. Also, from Table 5, physicians of all three specialties are compensated for higher frequency of lawsuits and while internists are the only specialists compensated for larger settlement magnitude. Internists and obstetrician-gynecologists' incomes suffer in response to higher malpractice insurance premiums. The coefficient on the cap indicator is positive for general surgeons and obstetrician-gynecologists, suggesting that in states with malpractice award caps, surgeons and obstetrician-gynecologists' incomes are, respectively, 5.5 and 6.5 percent higher than in states without caps. This finding is contrary to my hypothesis that the effect of the cap on income should be negative since having a cap on damage awards is an amenity. Perhaps a selection issue explains this finding: States with caps may have those caps because of their highly litigious environments, which is a disamenity for physicians. In this scenario, the cap indicator is actually serving as a proxy for any litigiousness not already captured by the other liability variables. Although I cannot interpret the coefficient for the cap variable causally, it is still an important control variable.

Included in the full sample are physicians working in a variety of settings, ranging from solo and group practices to hospitals, universities, or other institutions. It is plausible that the incomes of physicians working in the more traditional solo/group practice setting respond differently to liability risk and malpractice premium costs than do physicians employed by institutions. In order to investigate this possibility, I estimate

the state-year and state-year-specialty models for the subsample of physicians in more traditional solo or group practices; the results of these estimations are presented in Columns B and C of Table 4 and Column B of Table 5. Some differences among the results produced by the full and subsample estimations are evident. For the non-interacted state-year model (Column B, Table 4), only the malpractice insurance premium negatively affects physician income; unlike the full sample results, the subsample of group practice physicians shows that neither the frequency of payments nor the size of payments affects income. Also, for the state-year-specialty model, only the median payment size coefficient is (marginally) statistically significantly positive. For the interacted state-year model, however, the coefficient for frequency of payments is statistically significantly positive for two of the three specialties, median payment size has a positive effect for one specialty, and malpractice premium has a negative effect on income for two of the three specialties. Considering the results of the interacted and non-interacted state-year models for the subsample, it appears that the non-interacted results are more sensitive to exclusion of nontraditional practices. This may suggest that the effects of the variables of interest on income may be more heterogeneous across specialties within this subsample.

In my base specifications, I include two indicator variables describing each physician's compensation structure. *SALARIED* is equal to unity if the physician receives a salary, and *ADJUSTABLE_SALARY* is equal to unity if the physician is salaried and if the salary is adjustable within the current contract period based upon the performance of the physician and/or the practice. It is possible that these salary structure variables influence both income and at least one of the liability variables. For example,

perhaps the possibility of a bonus causes a physician to induce care (e.g., ordering unnecessary diagnostics) in an effort to increase revenues. This behavior might also have the effect of reducing the likelihood of being sued if, for example, a test that would not have otherwise been ordered happens to detect a disease that would otherwise not have been appreciated. In such a scenario, failing to control for physician compensation structure would result in omitted variables bias. Suppose, however, that, in order to compensate their physicians for bearing greater liability risk, a practice offers the possibility of a bonus. Then the salary structure variables ought not be included in the model. Columns D and E of Table 4 and column C of Table 5 display results from estimations of equations (1) and (2) without the variables *SALARIED* and *ADJUSTABLE_SALARY*. The results are essentially unchanged when the salary structure variables are excluded from the model.

A final analysis involves estimating the models with different combinations of the variables of interest. This serves to test the robustness of the results to exclusion of the variables of interest. There is not a high level of correlation among the variables of interest: The correlation between median and frequency is 0.014 and the corresponding figures are 0.465 for premium and frequency, and 0.055 for premium and median. This is consistent with Mello's (2006) observation that size and frequency of payments do not explain much of the variation in premiums. Tables 6 (non-interacted models) and 7 (interacted) suggest that the pattern of statistical significance for the coefficients of interest is similar when I drop the variables of interest, one or two at a time. Of the 18 models estimated, only three (columns B, E, and K in Table 6) show any differences in the significance of the variables of interest.

V. CONCLUSIONS

This paper examines the effects of medical malpractice liability on physicians' incomes. The evidence suggests that physicians in areas experiencing higher median settlement payments have incomes that are approximately 2.5 to 3 percent higher. Also, physician incomes are approximately 1 to 2 percent higher for physicians practicing in areas where lawsuits are more frequent. These findings suggest that physicians practicing in higher liability areas are compensated for bearing the risk of higher malpractice awards and a higher likelihood of being sued. In accord with anecdotes about the effect of malpractice insurance premiums on physicians' incomes, I find that higher premiums have a negative effect on physicians' incomes, which fall by approximately 28 to 31 percent of the amount of a premium increase. This result is consistent with sticky reimbursement rates, which may be caused, at least in part, by third party payers' increased use of prospective payment methods rather than fee-for-service reimbursement. The results are robust to a number of changes in specification.

This paper augments the existing literature in a number of ways. I improve upon the only other study that investigates the response of physicians' incomes to malpractice risk. Additionally, the data employed herein enables MSA-level analyses, thus allowing me to look within states. In addition to controlling for several physician-level factors that may affect income, I control for state-level unobservables that are not necessarily time invariant (e.g., changes in unobserved legislation or insurance regulations). I also investigate how different physician specialties respond to their differing levels of malpractice liability risk.

The evidence presented in this paper sheds light on another mechanism through which medical malpractice litigation can introduce higher costs into the health care system - through compensating wages. While defensive medicine is well-documented as an unintended, cost-increasing side effect of malpractice liability, the present paper is the only recent research demonstrating that physicians are compensated for bearing the risks associated with malpractice liability. Furthermore, as a result of the fee stickiness accompanying prospective payment systems, larger overhead in the form of higher insurance premiums tends to decrease physicians' incomes. These results suggest that policies limiting excessive litigation may help to reduce health care costs.

References

American Medical Association. https://catalog.ama-assn.org/Catalog/product /product_ detail.jsp?productId=prod240177?checkXwho=done (accessed 10 September 2007)

Appleby, J. (July 20, 2000). Frustrated doctors rebel against insurers. *USA Today,* 1B.

Boulton, G. (March 7, 2004). The price to practice. *Tampa Tribune (Tampa, Florida).*.

Clarke, S. (April 23, 2004). Riled Maryland doctors consider dumping coverage. *The Capital (Annapolis, Maryland).*.

Danzon, P. M., Pauly, M. V., & Kington, R. S. (1990, May). Incentive Effects of Medical Malpractice: The Effects of Malpractice Litigation on Physicians' Fees and Incomes. *AEA Papers and Proceedings, 80*(2), 122-127.

DeSimone, J., & Schumacher, E. J. (2004, October). Compensating Wage Differentials and AIDS Risk. *National Bureau of Economic Research Working Paper, No. 10861d.*

Dewey, J., & Rojas, G. (March 2008). *Inter-city Compensating Wage Differentials and Intra-city Workplace Centralization.*, Department of Economics and Bureau of Economic and Business Research (BEBR), University of Florida.

Dorschner, J. (August 25, 2007). Doctors discuss changes to FMA. *The Miami Herald (Miami, Florida).*.

Dubay, L., Kaestner, R., & Waidmann, T. (1999, August). The Impact of Malpractice Fears on Cesarean Section Rates. *Journal of Health Economics, 18*(4), 491-522.

Editorial Staff. (June 7, 2006). Not enough doctors. *Investor's Business Daily.*.

Hoff, T. J. (2004, Fall). Doing the Same and Earning Less: Male and Female Physicians in a New Medical Specialty. *Inquiry, 41,* 301-315.

Kessler, D., & McClellan, M. (1996, May). Do Doctors Practice Defensive Medicine? *Quarterly Journal of Economics, 111*(2), 353-390.

Krishnan, A. (July 1, 2006). Doctors' dollars shrinking, too. *The News & Observer (Raleigh, North Carolina),* D1.

MedLinePlus Medical Encyclopedia. (2008). *Doctor of Osteopathy (D.O.)*. Retrieved July 3, 2008, from National Library of Medicine: http://www.nlm.nih.gov/medlineplus/ency/article/002020.htm.

Mello, M. M. (2006). *Understanding Medical Malpractice Insurance: A Primer* (Research Synthesis Report No. 8). Robert Wood Johnson Foundation.

Miille, M. (May 13, 2002). The malpractice gamble; Rising malpractice insurance rates have forced doctors to consider risking their savings by going without insurance. *Sarasota Herald-Tribune (Sarasota, Florida).*

O'Neill, H., & Hennesy, K. (205). The Effects of Malpractice Tort Reform on Defensive Medicine. *Virginia Economic Journal, 10,* 75-87.

Pasko, T., & Smart, D. R. (Various years). *Physician Characteristics and Distribution in the US.* Chicago, IL: American Medical Association.

Piette, C. (2007). *Non-Economic Damage Caps and Medical Malpractice Claim Frequency: Is it Time for a Second Opinion?*, Department of Public Policy, University of North Carolina - Chapel Hill.

Rosen, S. (1986). Chapter 12: The Theory of Equalizing Differences. In O. C. Ashenfelter & R. Layard (Eds.), *Handbook of Labor Economics, Volume I* (pp. 641-691). Elsevier/North-Holland: Amsterdam.

Sasser, A. C. (2005). Gender Differences in Physician Pay: Tradeoffs between Career and Family. *The Journal of Human Resources, XL*(2), 477-504.

Skidmore, S. (December 3, 2002). Doctors' price tag causing many to 'go bare' in liability crisis. *Florida Times-Union (Jacksonville, Florida)*..

Solomont, E. (July 6, 2007). Rising insurance rates put city doctors out of business. *The New York Sun (New York)*..

Staff. (January 9, 2007). Las Vegas physicians face added pressures in an overstressed healthcare system. *PR Newswire US*..

The Kaiser Family Foundation and Health Research and Educational Trust. (2007). Employer Health Benefits 2007 Annual Survey. *accessed 7/1/08 at http://www.kff.org/insurance/7672/index.cfm*.

Thorpe, K., E. (2004, January 21). The Medical Malpractice 'Crisis': Recent Trends and the Impact of State Tort Reforms. *Health Affairs*, pp. W4-20 - W4-30.

Washburn, L. (July 17, 1998). HMOs put medical profession to the test. *The Record (New Jersey).*

Table 1. Summary Statistics

	Mean	Median	Max	Min	Std. Dev.
Real Income (internists, general surgeons and ob-gyns)	200,852	179,349	436,796	10,249	97,565
Number of malpractice payments per physician[1, 3]	0.22	0.12	12.74	0.01	0.67
Payments per physician (Internists) [1, 3]	0.14	0.10	1.67	0.01	0.15
Payments per physician (General Surgeons) [1, 3]	0.13	0.10	3.53	0.01	0.31
Payments per physician (Obstetrician-Gynecologists) [1, 3]	0.56	0.34	12.74	0.03	1.35
Real median of malpractice payments (all three specialties)[1, 3]	160,448	138,418	2,467,076	12,153	141,545
Real median of payments (Internists) [1, 3]	165,946	142,477	1,758,610	12,153	150,977
Real median of payments (General Surgeons) [1, 3]	144,738	128,702	683,021	22,547	81,209
Real median of payments (Obstetrician-Gynecologists) [1, 3]	172,072	149,805	2,467,076	23,391	184,373
Real premium (all three specialties)[2, 3]	24,538	18,431	166,482	772	22,199
Real premium (Internists) [2, 3]	9,756	7,882	52,086	772	7,220
Real premium (General Surgeons) [2, 3]	31,056	26,186	133,081	3,362	18,086
Real premium (Obstetrician-Gynecologists) [2, 3]	47,862	41,245	166,482	4,005	25,294
Years of experience	13.5	12	64	0	9.8
Number of weeks worked in previous year	47.6	48	52	26	3.2
Hours of medically-related work in previous week	54.8	55	84	20	13.2
% patient care practice revenue coming from Medicare	35.4	35	100	0	22.7
% patient care practice revenue coming from Medicaid	13.2	10	100	0	14.9
% patient care practice revenue coming from managed care	41.6	40	100	0	26.2
Number of managed care contracts	12.4	10	98	0	14.6
Salaried physician	0.52	1	1	0	0.5
Salary adjustable during contract period	0.19	0	1	0	0.4
Doctor of osteopathy	0.05	0	1	0	0.2
Graduate of foreign medical school	0.18	0	1	0	0.4
Female	0.17	0	1	0	0.4
Boarded	0.84	1	1	0	0.4

Number and proportion of physicians by practice type	#	%
Group practice (>2 physicians)	3,687	34.5
Solo/two physician practice	3,403	31.8
Medical School	1,158	10.8
Hospital Based	1,098	10.3
Other	872	8.2
HMO	475	4.4

Number and proportion of physicians by specialty	#	%
Internists	7,291	68.2
General Surgeons	2,549	23.8
Obstetrician-Gynecologists	853	8.0

N=10,693
[1] Variable at the MSA level.
[2] Variable at the state, within-state region, or MSA level, depending on data source.
[3] Summary measures calculated using one observation from each MSA-year-physician specialty cell.

Table 2. No Interactions
Dependent variable: natural log of real income, net of all expenses (including malpractice insurance premium)

	Equation (1) State-year fixed-effects	Equation (2) State-year-specialty fixed-effects
Payments per physician	0.0147 (0.0460)	0.0118 (0.3630)
Median payment size ($100,000s)	0.0206 (0.0280)	0.0204 (0.0260)
Premium ($1,000s)	-0.0014 (0.0050)	-0.0014 (0.0230)
Index	-0.0651 (0.5490)	-0.0419 (0.7540)
Doctor of osteopathic medicine	0.0341 (0.1190)	0.0347 (0.1110)
Foreign graduate	-0.0215 (0.1420)	-0.0234 (0.0890)
Female	-0.2323 (0.0000)	-0.2327 (0.0000)
Experience	0.0268 (0.0000)	0.0269 (0.0000)
Experience^2	-0.0007 (0.0000)	-0.0007 (0.0000)
Boarded	0.1233 (0.0000)	0.1198 (0.0000)
ln(weeks worked in previous year)	-0.0797 (0.2750)	-0.0755 (0.2670)
ln(hours worked in previous week)	0.3510 (0.0000)	0.3469 (0.0000)
% Practice income from Medicare	-0.0004 (0.0370)	-0.0005 (0.0400)
% Practice income from Medicaid	-0.0012 (0.0010)	-0.0013 (0.0000)
% Practice income from managed care	-0.0006 (0.0010)	-0.0006 (0.0020)
Number of managed care contracts	0.0019 (0.0000)	0.0018 (0.0000)
Salaried	-0.0566 (0.0000)	-0.0522 (0.0000)
Adjustable salary	0.0024 (0.8220)	0.0008 (0.9420)
General surgeon	0.2939 (0.0000)	
Obstetrician-gynecologist	0.2798 (0.0000)	
Adj. R^2	0.2695	0.1985
F	199.87	74.96
N	10,660	10,660
	Standard errors clustered by state-year	Standard errors clustered by state-year-specialty

P-values (two-tailed) in parentheses.
Estimated coefficients for practice type and year fixed-effects are omitted for brevity.

Table 3. With Interactions
Dependent variable: natural log of real income, net of all expenses (including malpractice insurance premium)

	Equation (1) State-year fixed-effects
Payments per physician (internists)*	0.1286 (0.0000)
Payments per physician (general surgeons)*	0.0383 (0.0190)
Payments per physician (ob-gyns)*	0.0137 (0.1240)
Median payment size (internists)* ($100,000s)	0.0176 (0.0400)
Median payment size (general surgeons)* ($100,000s)	-0.0073 (0.7400)
Median payment size (ob-gyns)* ($100,000s)	0.0238 (0.1850)
Premium (internists)* ($1,000s)	-0.0004 (0.3910)
Premium (general surgeons)* ($1,000s)	-0.0012 (0.0730)
Premium (ob-gyns)* ($1,000s)	-0.0006 (0.4580)
Index	-0.3781 (0.0010)
Doctor of osteopathic medicine	0.0326 (0.1360)
Foreign graduate	-0.0278 (0.0610)
Female	-0.2332 (0.0000)
Experience	0.0269 (0.0000)
Experience^2	-0.0007 (0.0000)
Boarded	0.1226 (0.0000)
ln(weeks worked in previous year)	-0.0796 (0.2780)
ln(hours worked in previous week)	0.3529 (0.0000)
% Practice income from Medicare	-0.0005 (0.0270)
% Practice income from Medicaid	-0.0013 (0.0000)

% Practice income from managed care	-0.0006 (0.0020)
Number of managed care contracts	0.0019 (0.0000)
Salaried	-0.0557 (0.0000)
Adjustable salary	0.0031 (0.7740)
General surgeon	0.3445 (0.0000)
Obstetrician-gynecologist	0.2621 (0.0000)
Adj. R^2	0.2712
F	282.03
N	10,660
	Standard errors clustered by state-year

*For interacted variables, the omitted specialty is internist. The reported estimates for surgeons and ob-gyns are equal to the sum of the internist coefficient and the interacted coefficient.
P-values (two-tailed) in parentheses.
Estimated coefficients for practice type and year fixed-effects are omitted for brevity.

Table 4. Further investigation, no interactions.
Dependent variable: natural log of real income, net of all expenses (including malpractice insurance premium)

	(A) State and year fixed-effects	(B) State-year fixed-effects, excluding institutional physicians	(C) State-year-specialty fixed-effects, excluding institutional physicians	(D) State-year fixed-effects, excluding salary variables	(E) State-year-specialty fixed-effects, excluding salary variables
Payments per physician	0.0147	0.0162	0.0055	0.0147	0.0124
	(0.1460)	(0.2520)	(0.7760)	(0.0490)	(0.3370)
Median payment size ($100,000s)	0.0145	0.0195	0.0216	0.0196	0.0194
	(0.0940)	(0.1450)	(0.1080)	(0.0360)	(0.0340)
Premium ($1,000s)	-0.0010	-0.0012	-0.0009	-0.0014	-0.0015
	(0.0390)	(0.0270)	(0.1150)	(0.0040)	(0.0110)
Cap	0.0092				
	(0.5330)				
Adj. R^2	0.2700	0.2251	0.1697	0.2678	0.1969
N	10,660	7,071	7,071	10,693	10,693

P-values (two-tailed) in parentheses.

Table 5. Robustness, with interactions.
Dependent variable: natural log of real income, net of all expenses (including malpractice insurance premium)

	(A) State and year fixed-effects	(B) State-year fixed-effects, excluding institutional physicians	(C) State-year fixed-effects, excluding salary variables
Payments per physician (internists)*	0.1346	0.1197	0.1310
	(0.0000)	(0.0000)	(0.0000)
Payments per physician (general surgeons)*	0.0465	0.0636	0.0377
	(0.0060)	(0.0000)	(0.0180)
Payments per physician (ob-gyns)*	0.0164	0.0015	0.0137
	(0.0280)	(0.9220)	(0.1250)
Median payment size (internists)* ($100,000s)	0.0127	0.0141	0.0169
	(0.0510)	(0.2660)	(0.0500)
Median payment size (general surgeons)* ($100,000s)	0.0000	0.0105	-0.0096
	(0.9980)	(0.6530)	(0.6620)
Median payment size (ob-gyns)* ($100,000s)	0.0058	0.0366	0.0207
	(0.7850)	(0.0510)	(0.2560)
Premium (internists)* ($1,000s)	-0.0008	-0.0010	-0.0004
	(0.0190)	(0.0560)	(0.3580)
Premium (general surgeons)* ($1,000s)	-0.0014	-0.0017	-0.0012
	(0.0550)	(0.0120)	(0.0740)
Premium (ob-gyns)* ($1,000s)	-0.0007	-0.0001	-0.0006
	(0.4480)	(0.9270)	(0.4620)
Cap (internists)*	-0.0111		
	(0.5660)		
Cap (general surgeons)*	0.0551		
	(0.0070)		
Cap (ob-gyns)*	0.0658		
	(0.0440)		
Adj. R^2	0.2725	0.2261	0.2695
N	10,660	7,071	10,693

*For interacted variables, the omitted specialty is internist. The reported estimates for surgeons and ob-gyns are equal to the sum of the internist coefficient and the interacted coefficient.
P-values (two-tailed) in parentheses.

Table 6. Dropping variables of interest, no interactions.
Dependent variable: natural log of real income, net of all expenses (including malpractice insurance premium)

	(A) State-year fixed-effects, excluding frequency	(B) State-year-specialty fixed-effects, excluding frequency	(C) State-year fixed-effects, excluding median	(D) State-year-specialty fixed-effects, excluding median	(E) State-year fixed-effects, excluding premium	(F) State-year-specialty fixed-effects, excluding premium
Payments per physician			0.0163	0.0136	0.0060	0.0026
			(0.0260)	(0.2970)	(0.3960)	(0.8260)
Median payment size ($100,000s)	0.0217	0.0211			0.0207	0.0203
	(0.0200)	(0.0210)			(0.0270)	(0.0270)
Premium ($1,000s)	-0.0010	-0.0008	-0.0014	-0.0014		
	(0.0260)	(0.2930)	(0.0050)	(0.0340)		
Cap						
Adj. R^2	0.2694	0.1984	0.2692	0.1981	0.2691	0.1984
N	10,660	10,660	10,660	10,660	10,660	10,660

P-values (two-tailed) in parentheses.

	(G) State-year fixed-effects, excluding frequency and median	(H) State-year-specialty fixed-effects, excluding frequency and median	(I) State-year fixed-effects, excluding frequency and premium	(J) State-year-specialty fixed-effects, excluding frequency and premium	(K) State-year fixed-effects, excluding median and premium	(L) State-year-specialty fixed-effects, excluding median and premium
Payments per physician					0.0075	0.0045
					(0.2740)	(0.7070)
Median payment size ($100,000s)			0.0212	0.0206		
			(0.0220)	(0.0240)		
Premium ($1,000s)	-0.0009	-0.0007				
	(0.0350)	(0.3880)				
Cap						
Adj. R^2	0.2689	0.1980	0.2692	0.1984	0.2688	0.1980
N	10,660	10,660	10,660	10,660	10,660	10,660

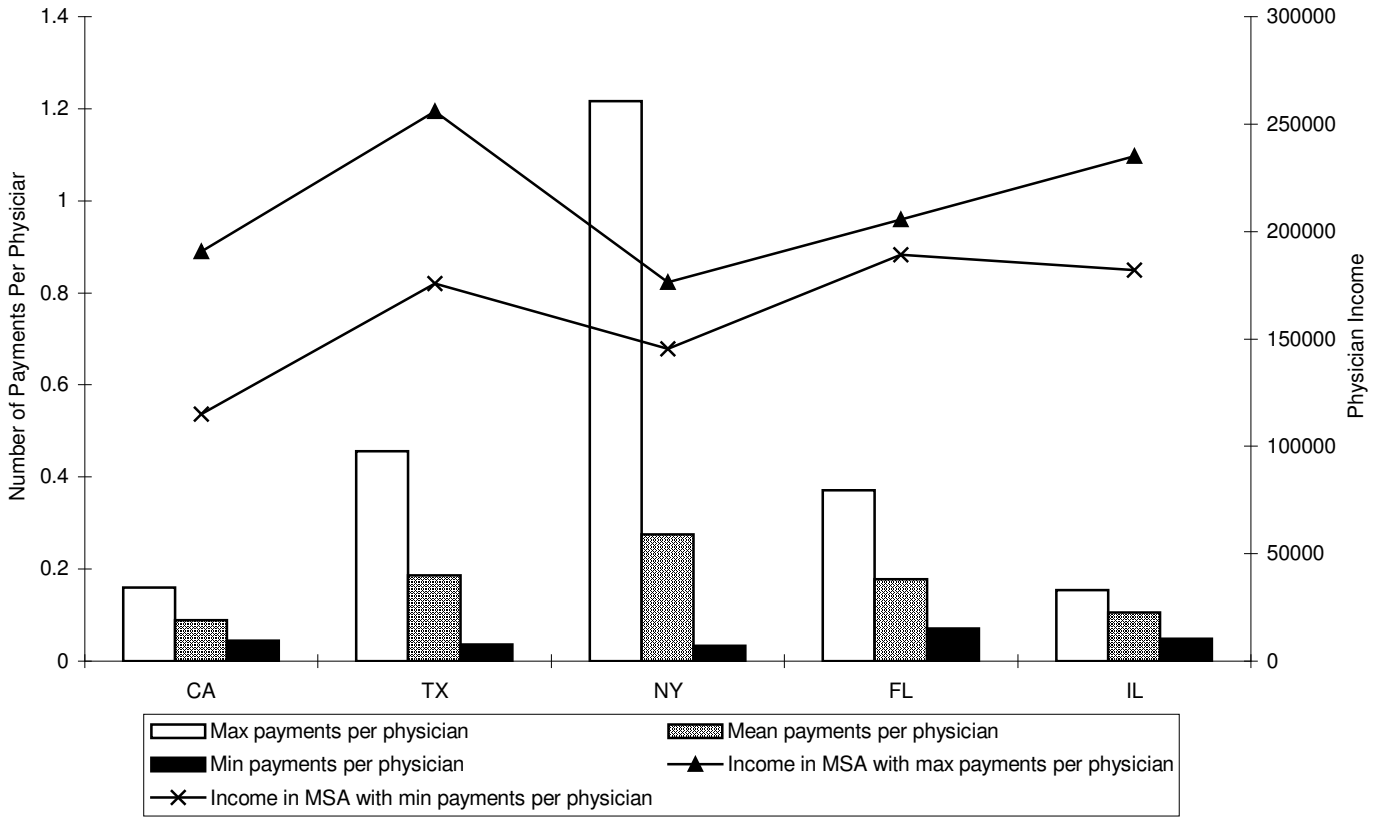
P-values (two-tailed) in parentheses.

Table 7. Dropping variables of interest, with interactions.
Dependent variable: natural log of real income, net of all expenses (including malpractice insurance premium)

	(A) State-year fixed-effects, excluding frequency	(B) State-year fixed-effects, excluding median	(C) State-year fixed-effects, excluding premium	(D) State-year fixed-effects, excluding frequency and median	(E) State-year fixed-effects, excluding frequency and premium	(F) State-year fixed-effects, excluding median and premium
Payments per physician (internists)*		0.1341	0.1305			0.1360
		(0.0000)	(0.0000)			(0.0000)
Payments per physician (general surgeons)*		0.0434	0.0241			0.0264
		(0.0090)	(0.0620)			(0.0400)
Payments per physician (ob-gyns)*		0.0148	0.0101			0.0111
		(0.0950)	(0.1180)			(0.0840)
Median payment size (internists)* ($100,000s)	0.0238		0.0179		0.0239	
	(0.0110)		(0.0380)		(0.0110)	
Median payment size (general surgeons)* ($100,000s)	0.0024		-0.0107		-0.0022	
	(0.9130)		(0.6200)		(0.9200)	
Median payment size (ob-gyns)* ($100,000s)	0.0329		0.0227		0.0312	
	(0.0760)		(0.2050)		(0.0910)	
Premium (internists)* ($1,000s)	-0.0002	-0.0003		-0.0001		
	(0.9000)	(0.4750)		(0.9560)		
Premium (general surgeons)* ($1,000s)	-0.0013	-0.0013		-0.0014		
	(0.0350)	(0.0390)		(0.0280)		
Premium (ob-gyns)* ($1,000s)	-0.0006	-0.0006		-0.0005		
	(0.2950)	(0.4520)		(0.3270)		
Cap (internists)*						
Cap (general surgeons)*						
Cap (ob-gyns)*						
Adj. R^2	0.2695	0.2708	0.2711	0.2690	0.2693	0.2707
N	10,660	10,660	10,660	10,660	10,660	10,660

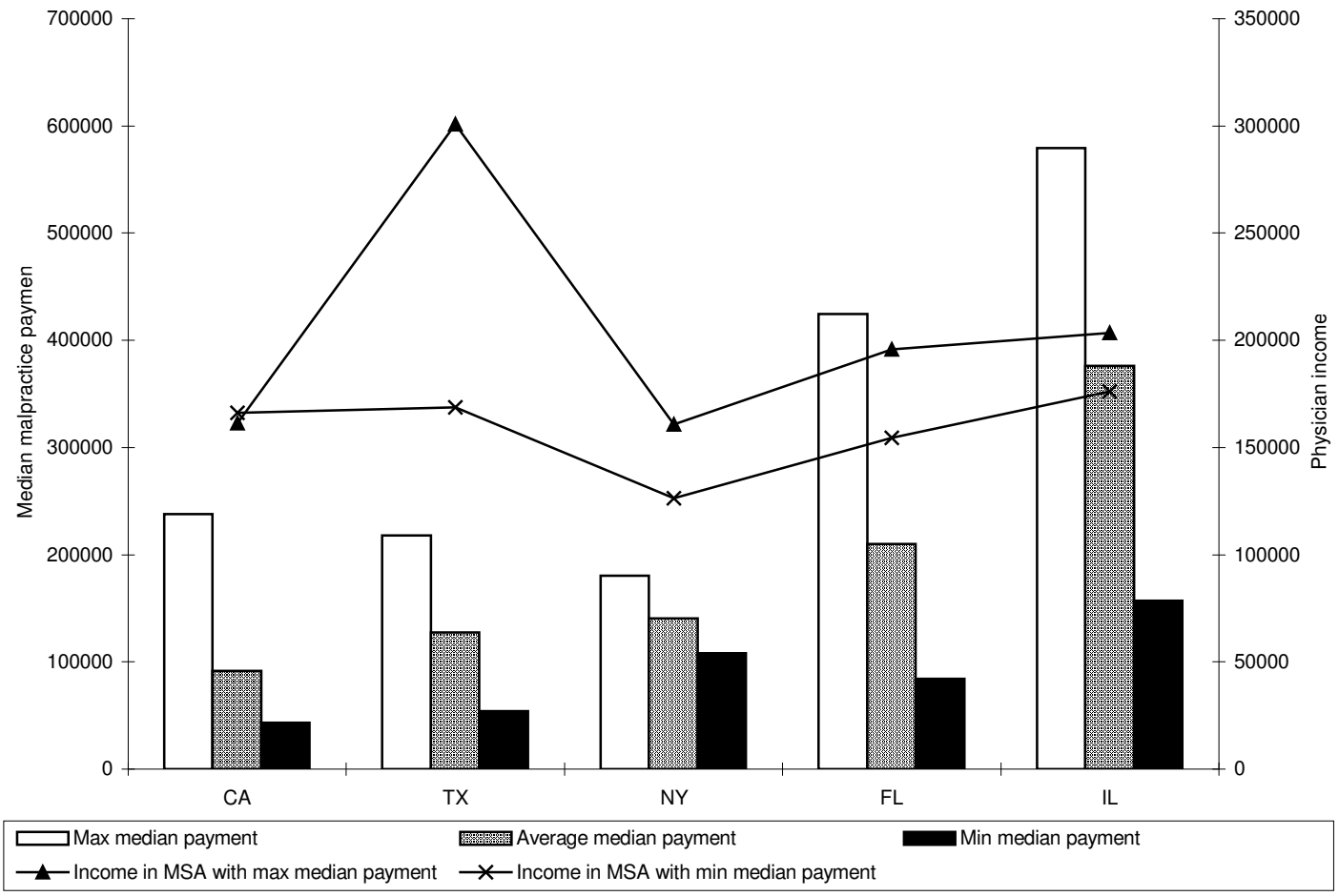
*For interacted variables, the omitted specialty is internist. The reported estimates for surgeons and ob-gyns are equal to the sum of the internist coefficient and the interacted coefficient.
P-values (two-tailed) in parentheses.

Figure 1. Min, Max and Mean Number of Malpractice Payments per Physician* and Physicians' Incomes**



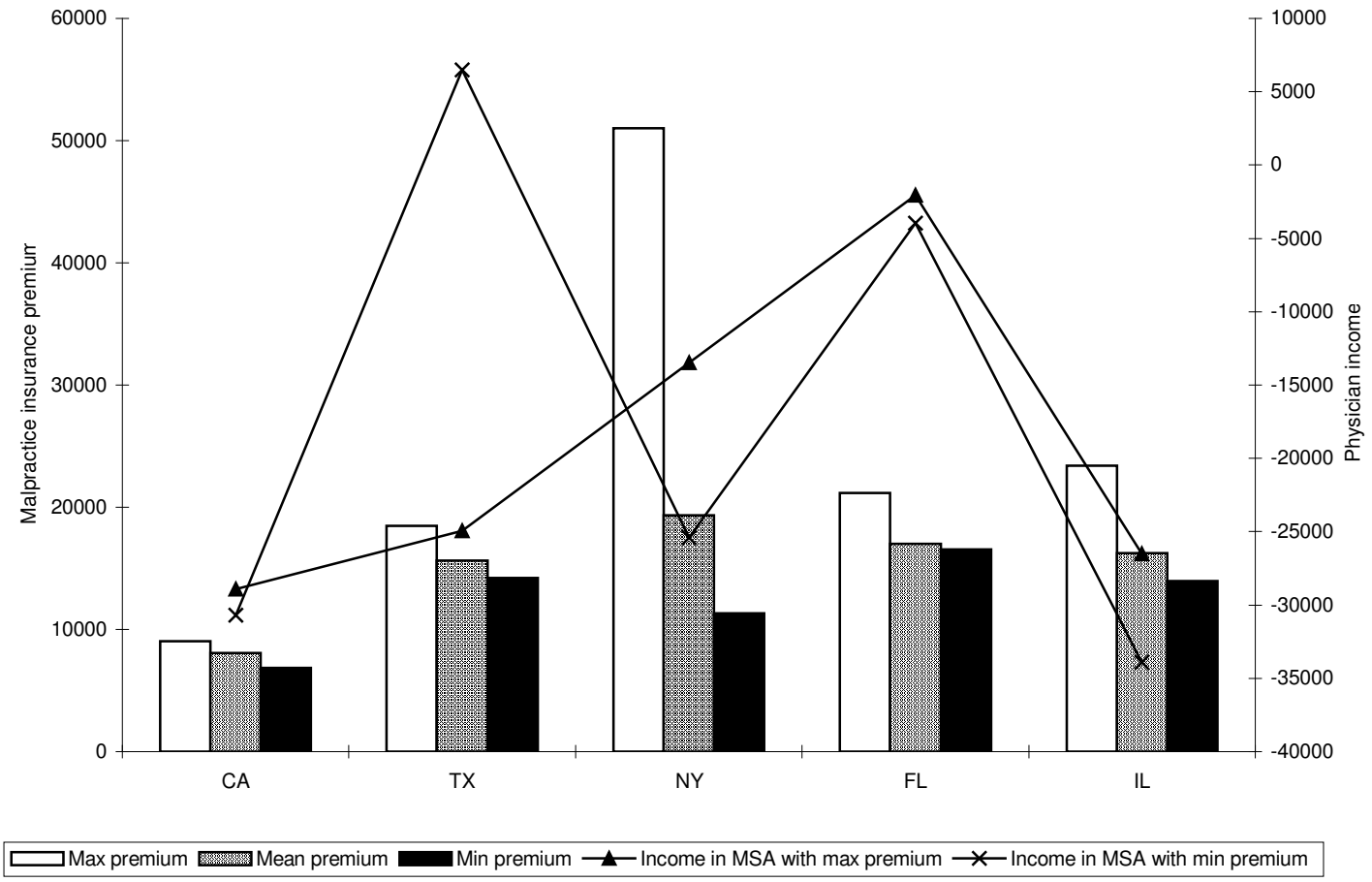
Max (min) payments per physician: Four-year average of the number of payments per physician in the MSA with the max (min) number of payments per physician in each year. Mean payments per physician: Four-year average of the mean number of payments per physician in each state.
**Income in MSA with max (min) payments per physician: Four-year average of mean physician income in the MSA with the max (min) number of payments per physician

Figure 2. Minimum and Maximum Median Malpractice Payments* and Physicians' Incomes**



*Max (min) median malpractice payments: Four-year average of the median payment size in the MSA with the max (min) payment size in each year. Average median payment:Four-year average of the mean payment size in each state.
**Income in MSA with max (min) median payment: Four-year average of mean physician income in the MSA with the max (min) median payment size.

Figure 3. Min, Max and Mean Malpractice Insurance Premiums* and Physicians Incomes**



*Max (min) malpractice insurance premiums: Four-year average of the premium in the MSA with the max (min) premium in each year.
Mean premium: Four-year average of the mean premium in each state.
**Income in MSA with max (min) premium: Four-year average of mean physician income in the MSA with the max (min) premium (incomes are adjusted for size and frequency of payments).

Figure 4A: Frequency of Malpractice Payments by Specialty Over Time: California

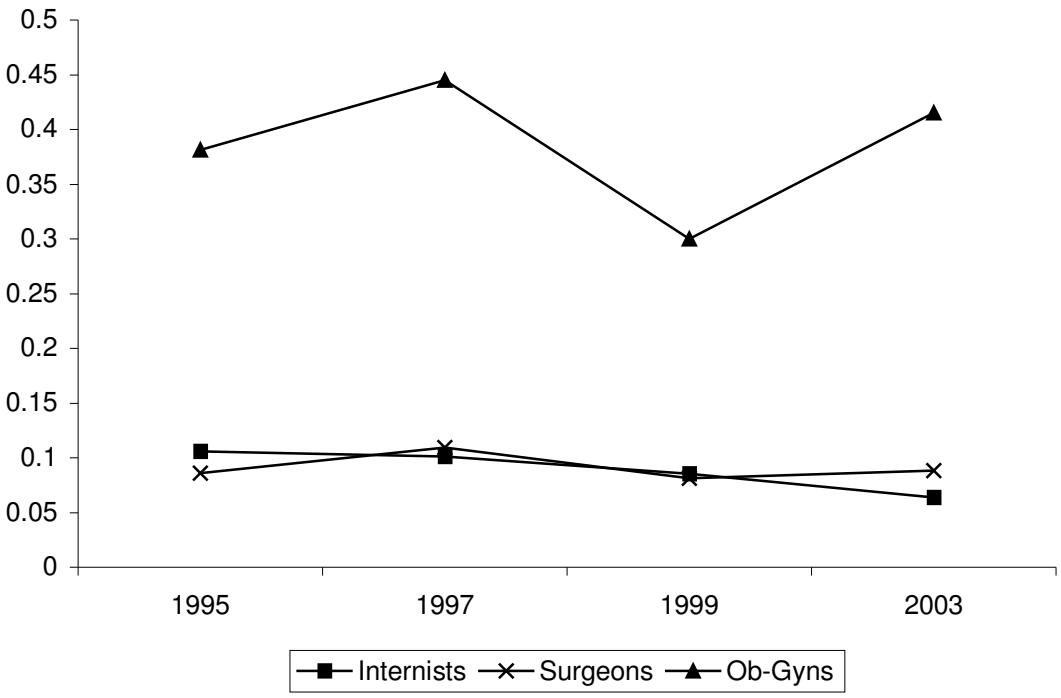


Figure 4B: Frequency of Malpractice Payments by Specialty Over Time: Texas

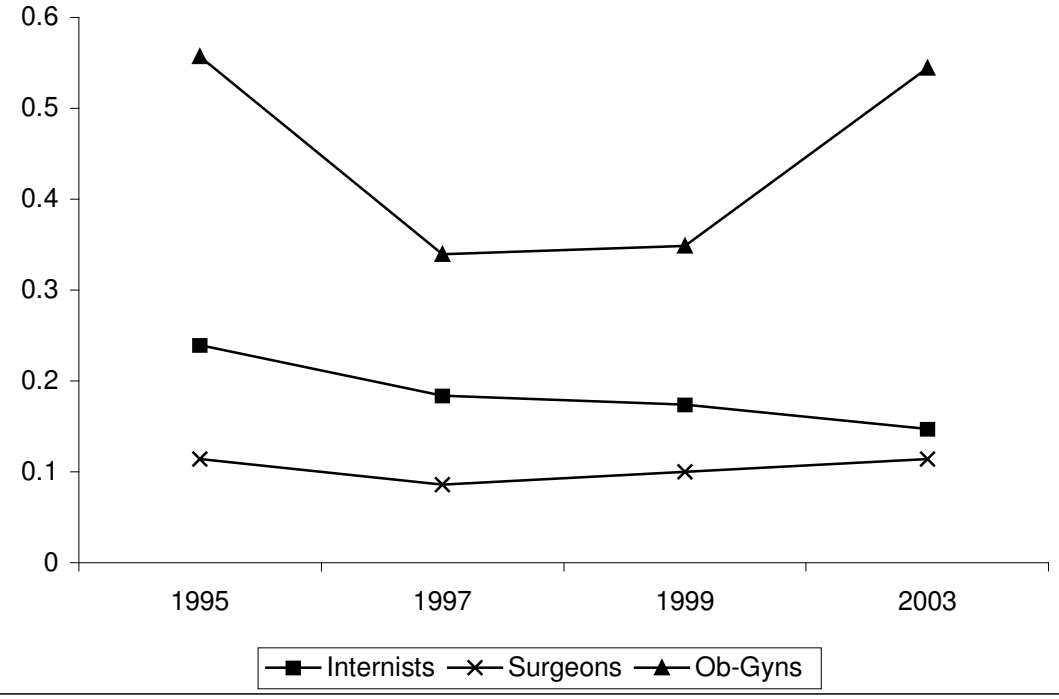


Figure 4C: Median Malpractice Payments by Specialty Over Time: California

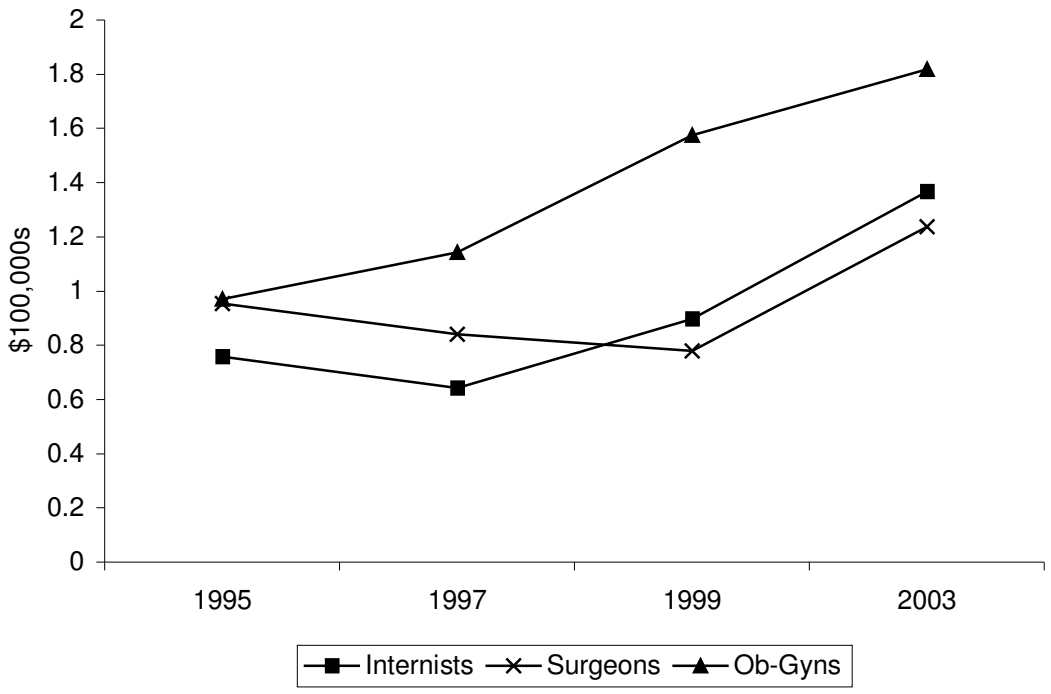
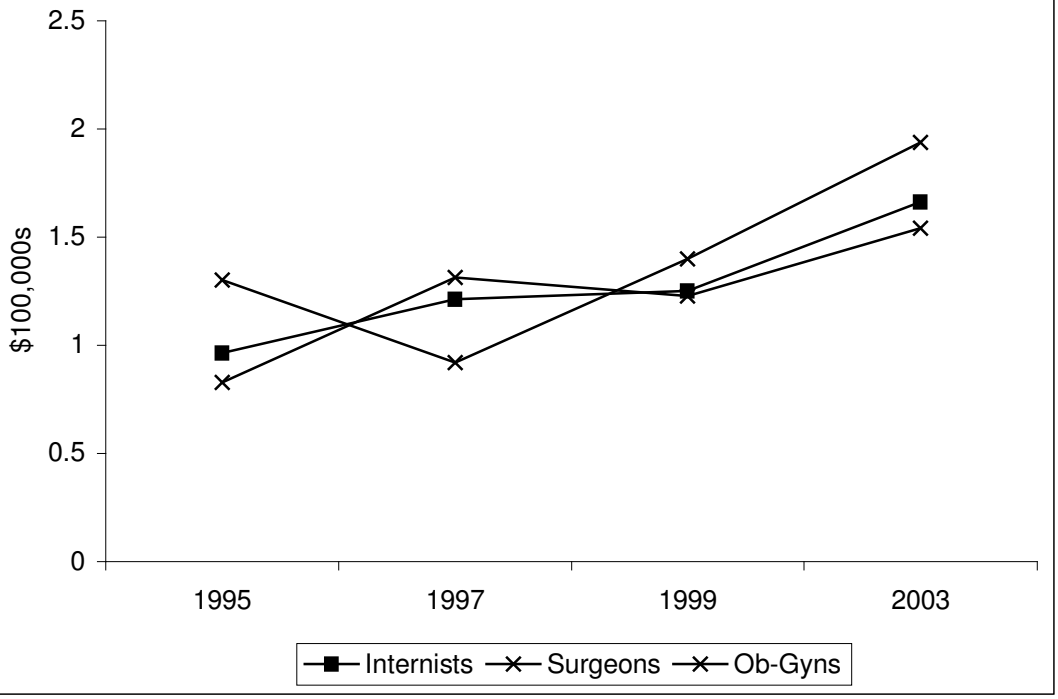


Figure 4D: Median Malpractice Payments by Specialty Over Time: Texas



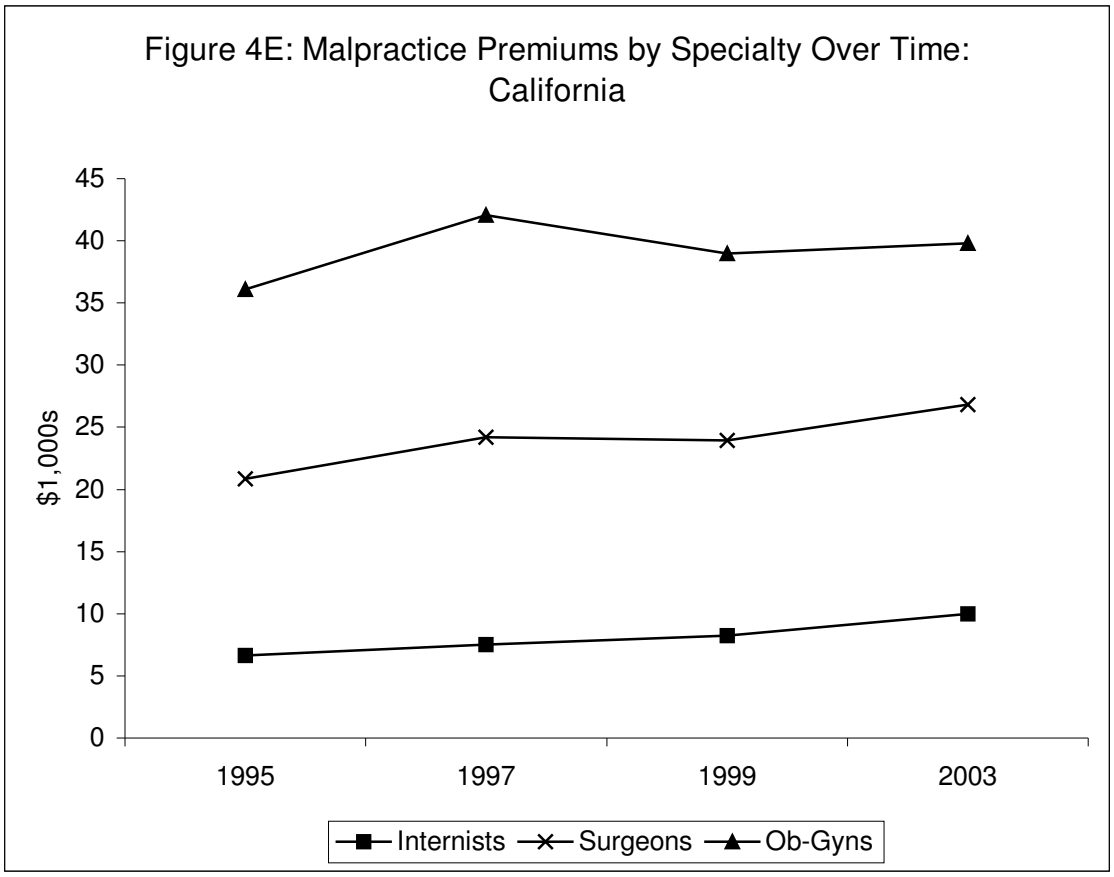


Figure 4E: Malpractice Premiums by Specialty Over Time: California
$1,000s
45
40
35
30
25
20
15
10
5
0
1995
1997
1999
2003
Internists
Surgeons
Ob-Gyns

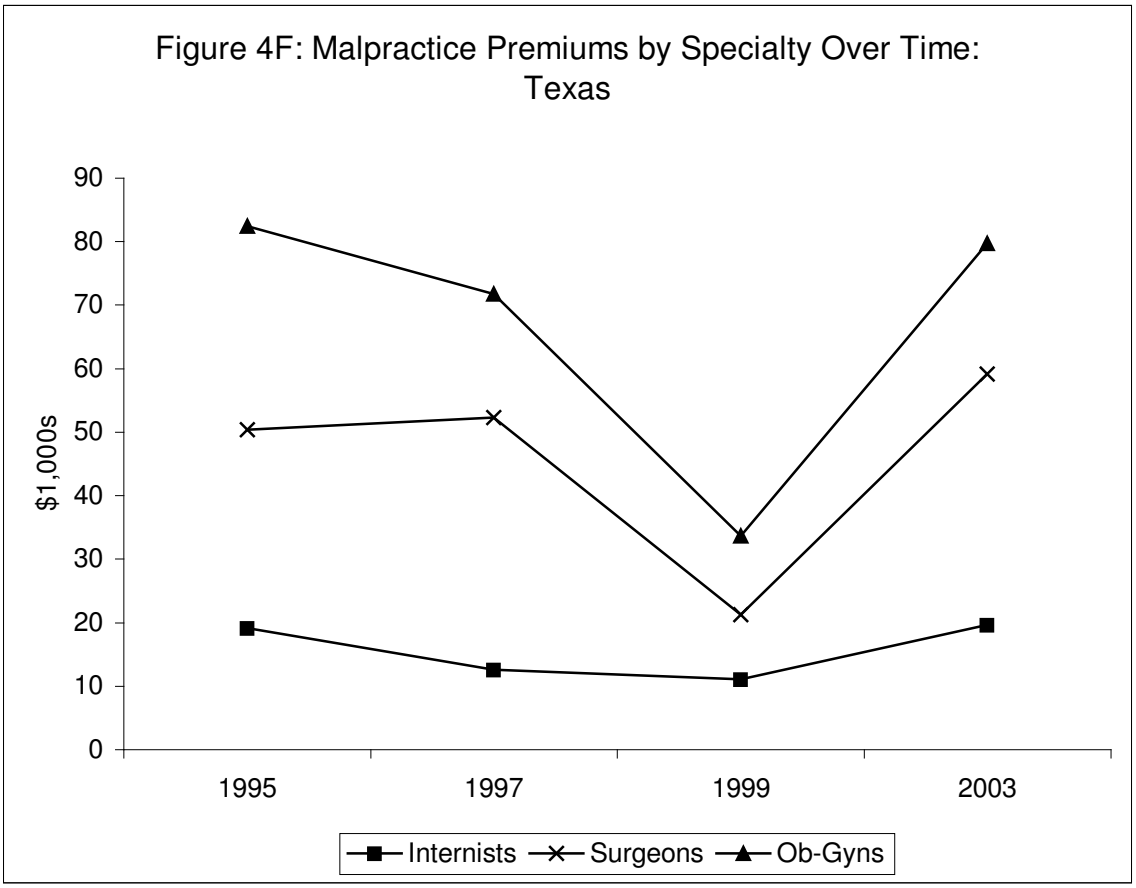
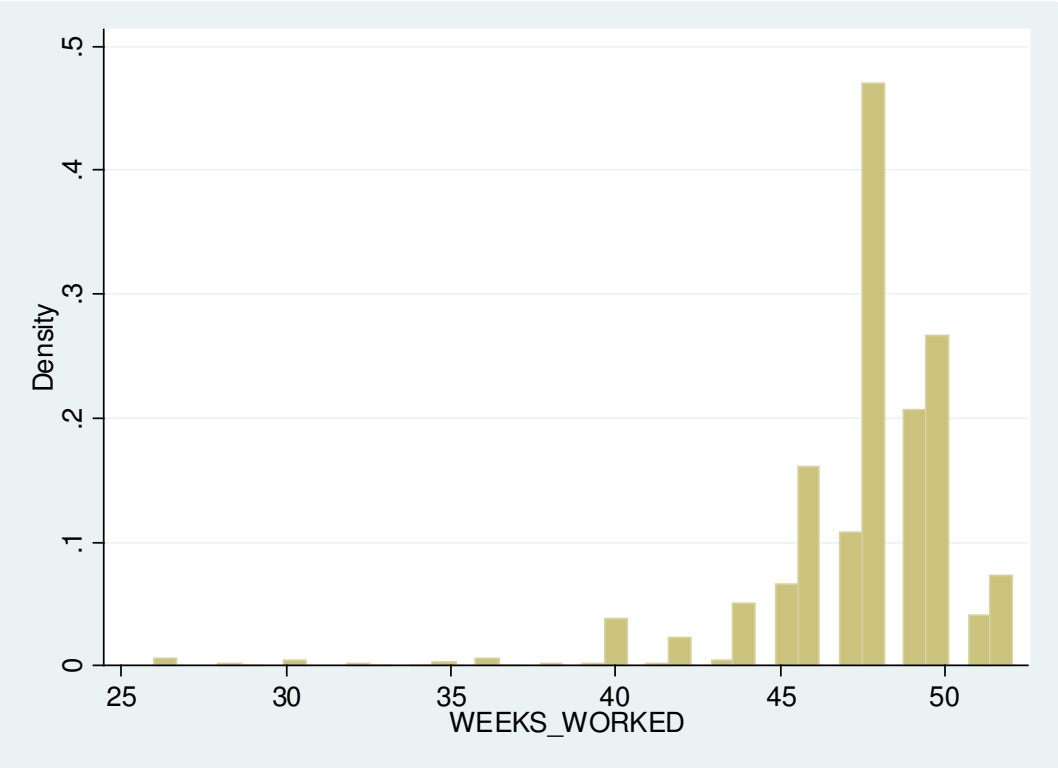


Figure 4F: Malpractice Premiums by Specialty Over Time: Texas
$1,000s
90
80
70
60
50
40
30
20
10
0
1995
1997
1999
2003
Internists
Surgeons
Ob-Gyns

Figure 5. Histogram of Weeks Worked Variable



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

Internists

Diagnosis Related
Medication Related
IV & Blood Products Related
Treatment Related
Monitoring Related
Behavioral Health Related

General Surgeons

Diagnosis Related
Anesthesia Related
Surgery Related
Medication Related
IV & Blood Products Related
Treatment Related

Obstetrician-Gynecologists

Diagnosis Related
Anesthesia Related
Surgery Related
Medication Related
Obstetrics Related
Treatment Related
Monitoring Related