Malpractice Liability Crisis and Physician Location Choice

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Abstract

In this paper we analyze the impact of recent crisis in medical liability insurance on physician supply. Following increased premiums and reduced access to liability insurance, there has been conflicting reports on the physician reaction. Using a simple model we first show that physicians will likely increase their case load to the extent which premiums are independent of the case load. We also explore the effects of uncertainty and predict that established physicians will likely wait until the uncertainty over the crisis is resolved. Using structural econometric methods we perform empirical tests on a series of data sets that show location choice of new and established physicians. We find that while the total number of physicians is not significantly affected by the crisis, new physicians are less likely to start practice in states that are in crisis. The effect is significant for those who are graduates of medical schools that are not ranked.

1 Introduction

The last few years witnessed a crisis in medical liability insurance sector. Among increasing premiums, and the heated debate on causes of and remedies for the crisis, conflicting reports on the response of physicians to the malpractice liability crisis has emerged. US Department of Health and Human Services Report (2002) provided incidental examples of physicians leaving states with high premiums arguing that the impact was significant. A GAO report (2003_b), on the other hand, refuted some of these incidental evidence and concluded that the change was local and not widespread. Despite the clear importance of the issue there exists no formal analysis on the effects of recent crisis on physician location choice.

This study uses a series of data sets to analyze the effect of medical liability crisis on location choice for physicians of different characteristics at different stages of career.

Medical liability refers to the liability of the physician as to the negative outcomes of her practice resulting form negligence on her part. Liability for malpractice is potentially efficient in providing incentives for a physician to provide care of "appropriate" quality and, hence, to avoid "negligent" behavior. In realistic settings, however, it is frequently hard for the patient and third parties, such as courts, to determine whether the "appropriate" care was provided and to identify "malpractice". As a result, when an adverse outcome occurs, there can be a malpractice claim against the physician even if there is no negligence.

To avoid the uncertainty associated with costly court processes and financial settlements, physicians buy malpractice insurance. As frequency of claims and jury awards increase, and as returns on insurance companies' investments decrease, insurance companies raise the premiums or go out of malpractice insurance market. The common claim is that physicians, constrained by HMOs and other cost containment mechanisms, cannot fully pass through the additional costs of liability to the patients. The resulting decrease in physicians' net revenues leads physicians to retire early or to move to more favorable locations.

In the next section we present a simple model describing how physicians react to the change in malpractice pressure. We first assume away exit from and entry to the market. Physicians decide on the case load. The effects of increased premiums depends on whether the premiums are tied to the case load of the physicians. If the malpractice pressure is independent of the case load physicians increase their case load, due to the income effect, assuming that they do not leave the market altogether. Otherwise the effect could be the reverse since the returns to treating an additional patient is lower with higher premiums.

Given the adjustments in case load during the crisis, we analyze the decision on practice location. In that point our model emphasize an important but often overlooked complexity: uncertainty. An important factor that would affect physicians' relocation or retirement decision is their expectations on the permanence of the high and increasing malpractice premiums. High premiums could be due to increasing liability claims paid or it could be due to the adverse conditions in investment markets. The recent developments may be temporary or conditions could change due to new legislation as was the

case in earlier years when the crisis hit the market.

The model assumes that physicians do not know whether the crisis is permanent or temporary. Physicians use yearly observations to update their beliefs on permanency of the crisis and decide whether to move to best alternative or wait for another period. In such a scenario, even if the rates increase we might observe no change in physician supply. Our model predicts that the adjustment of the physicians to the crisis and uncertainty around the duration of the crisis would largely limit the effects of the crisis on physician supply. We expect to see no significant difference in the supply of established physicians while the new physicians would be affected because for them it is more difficult to adjust to the crisis and less costly to move than it is for established physicians.

Implications of uncertainty does also affect the empirical methods. As the adjustment to the crisis takes time, a fixed effects model is inadequate. For that reason in empirical work we rather look at how the variables that measure the effect of the crisis change over time. We assume that physicians have knowledge on the extent of the crisis but they do not know how long it will last. We regress physician supply on the interaction of change in malpractice pressure and time dummies.

While analyzing the change in physician location choice as a response to increasing malpractice pressure, we also focus on diversity among physicians. Previous literature on physician location choice[1] has mostly considered physicians as a homogeneous body. There is, however, differences among physicians that might affect their response to changing market conditions. Physicians at early stages of their career have lower relocation costs and there are differences in knowledge and ability of physicians that causes them to attract different markets with different abilities to pay. Those differences, if reflected in the response to the crisis, would be crucial in assessing the impact of increased premiums and its consequences for health care.

For that reason our model allows for demand function to differ across physicians. Recognizing that physicians could be affected differently in different stages of their career we are using a series of data

[1] Location choice of the physicians has been studied extensively. Emphasis has been on understanding why physician supply differs across regions and alternative policies to deal with it. Newhouse et.al. (1982) uses reduced form analysis and shows that physician location follows economic models' predictions. Hurley (89) and Bolduc et. al. (96) use more structural utility theoretic models and discrete choice methods to estimate the effect of incentive structures on location choice. In a more recent work Polsky et.al. focused on the effect of HMO expansion on location choice using a discrete choice model based on physician utility maximization.

sets, such as the number of positions offered and filled by residency programs, actual location choice of new graduates, changes in total number of physicians, and practices of established physicians. We also interact other physician characteristics, such as citizenship, medical school, race and gender, with the malpractice pressure variables to see differences in the effects of the malpractice crisis across physicians.

The analysis of residency program and location choice after residency reflects the effects of premiums on initial location choice. There is no clear evidence as to when that decision is made and our data shows that both stages play role in location choice. For residency choice our data is limited to number of positions offered and filled. This allows us to do a difference in difference study to compare locations under different pressures as those pressures change.

In terms of after residency we have a richer data set. We are able to observe practice and location choice of all new physicians. We estimate physician utility function by a structural econometric model. We use random coefficients model as well as a conditional logit model. Unlike usual logit models random coefficients model allows the coefficients for independent variables to differ across individuals rather than assuming a fixed coefficient. Use of this method creates problems in calculation of likelihood functions and those are dealt using simulation techniques.

Our analysis on established physicians focuses on data from state of Florida. Specifically we analyze the characteristics of quitters and stayers. We analyze whether they differed in their practice style and personal characteristics [work in progress].

To measure the malpractice pressure we are using a number of variables. First we compare those states labeled as "crisis states" by American Medical Association (AMA) to others. We also have information on the malpractice insurance premiums and the number of malpractice cases as well as the total payments in those cases. We argue that the change in the extent of malpractice pressure can be measured by the deviation from the mean values of those measures in late 1990s when the markets were stabilized.

Empirical work focuses on obstetrics/gynecology specialty [internal medicine and general surgery will be added later]. Ob/Gyns have been subject to malpractice liability cases very often. According to a survey by American College of Obstetricians and Gynecologists (ACOG 2003) %76 of OB/Gyns have reported to have been sued at least once during their career. They rank first in the number of claims and cost to defend. Similarly they are one of the specialties that pay highest premiums. They also are a

crucial part of health sector. A Time article (Berestein 2003) reported that women had to drive 50 miles to get to the closest delivery room in the region. Ob/Gyns have also been often analyzed in previous literature for the impact of medical liability on defensive medicine[2].

The change in physician supply has important consequences. A reduced number of physicians will make health care less accessible to patients assuming that there was no excess supply to begin with. That will be more important for those at the lower ranks of society because remaining physicians will primarily prefer patients who are more able to pay. The problem of health care access that is already prevalent for Medicaid patients will become even more serious. On the other hand, a redistribution of physicians from metropolitan areas where premiums are high to rural areas where premiums are relatively lower could alleviate the shortage of physicians in rural areas.[Ref.]

The paper will be the first to assess the impact of recent crisis on physician supply. There is some work on the effect of medical liability legislation on physician supply. Hellinger and Encinosa (2003) find that states with caps on malpractice awards attracted more physicians than those without caps. Klick and Strattman (2003) show that the physician supply depends on the tort reforms. Both works use aggregate data and do not differentiate between physicians.

In the next section we will summarize the medical liability system and recent crisis. Then we will present a simple model of physician reaction to the crisis and discuss its implications for empirical work. Section four will present data and empirical methodology. This will be followed by results in section five. We will conclude in section six.

2 Malpractice liability

Malpractice liability is designed to provide incentives for the physician to provide proper care to the patient and to compensate patients in case physician is negligent. Ideally tort system should be such that punishments should provide incentives to physicians to provide optimal care. Health sector, however, contains important informational characteristics that complicates design of a working system. It is

[2] Most work on medical liability have focused on defensive medicine practices–those practices that do not change the outcome of the treatment but provides a shield to the physicians in case of a claim. See Dubay, Kaestner, and Waidmann (1999) for a recent work on the effect of malpractice liability on c-section deliveries.

difficult for parties involved (physicians and patients) as well as outsiders (legal system) to assess whether a negligent act were performed by the physician. That difficulty on how to assess due care is solved by referring to "accepted practice". This still leaves a lot of room for interpretation because medical cases are often hard to categorize.[3]

The amount of uncertainty in the process leads physicians to insure themselves against the adverse effects of malpractice cases. Insurance company takes the responsibility for defending the physician in the court and make the necessary payments. In order to cover their expected costs companies charge premiums to physicians according to the malpractice risk they are covering. Even with the insurance, there are costs to the physician of malpractice liability. When they face a claim they often have to spend time in the court and they risk losing reputation. According to ACOG (2003) average claim takes four years until it is resolved.

Current market is shaped by previous malpractice crisis. Almost every decade crisis, mild or hard, hit insurance market and were characterized by higher premiums and exit of insurance companies. In mid 1970s insurance rates increased by as much as 300% in some states. Many companies stopped underwriting medical liability insurance. The crisis led to tort reforms. In many states physicians established own mutual insurance companies or state underwriting agencies covered those physicians who could not find anyone to insure them. While the crisis rescinded following reforms, it hit back in 1980s with high prices (see Danzon ??). 1990s have been relatively smooth partially due to soaring stock market proceeds. Resulting insurance industry is composed of many physician owned mutual liability companies, state underwriting agencies, mandatory pools, etc. States vary in legislation on malpractice liability. Many have caps on malpractice awards, restrictions on lawyer fees etc.

The current crisis in malpractice liability started around 2000. Starting in late 1990s there were warnings of the coming crisis. Medical Liability Monitor stated in its ?? issue that the premiums were too low due to competition and that there was an expectation for an increase. Premiums made a jump after 2000. Some major insurance companies such as St. Paul which handled 10% of physician liability market (ACOG 2003) stopped writing malpractice insurance and many others did not take new customers.

[3]This does not necessarily mean that the system is bad because its full impact can be measured only by carefull investigation of all its aspects. This paper will not attempt to make such an analysis and will avoid to make normative statements on those aspects of the issue. See Danzon (1988) for an analysis of costs and benefits of the system.

The reasons for the increase were discussed in various forums. A GAO report (2003_a) argued that there were more than one reason for the crisis and listed increasing number of claims and payments, decrease in the return to investment, and increased competition in 1990s that draw the prices down among the major causes. Parties involved in the medical liability tended to emphasize one or the other of these reasons according to their priorities. In the last two years efforts to pass legislation on malpractice liability has intensified and recently Florida, Ohio and Texas have passed laws establishing caps on malpractice awards. The effects of these on the premiums is yet to be seen.

3 Model

Literature on physician location considers physician as a utility maximizing individual where indirect utility is a function of income and leisure. Income is generated through health services provided to patients. The effect of the increasing malpractice premiums are likely through the income. The reaction by physicians could be in two forms. They could stay in the market but change their workload and possibly affect the prices. They could also change location and move to a new place where malpractice liability burden is lower. While these two are not independent processes, we will first keep the number of physicians constant and look at the adjustment process. Then we will analyze how the number of physicians is determined and then we will combine the findings and discuss its implications for empirical work.

3.1 Adjustment to crisis

Health care sector is a market with its own peculiarities. It could be described as a differentiated products market in that physicians provide care of differing quality and location. Pricing mechanism, however, is complicated. Patients rarely pay for the services they receive. Most are insured by private companies or government.

In earlier times, before 1980s, a patient driven demand were in place (Dranove, Shanley and White 1993). Insurers and government would pay providers based on costs of treatment and were not allowed to steer patients to physicians of their choice. As the payment was done by insurers, the choice was based purely on perceived quality of the physician. Since 1980s, however, system has been subject to major changes. Labeled as payer driven demand, the new structure allowed the insurance companies to

direct patients to a select group of physicians. Insurance companies negotiated prices with providers.

Government payments are predetermined fees that are periodically adjusted for changes in the costs. They are also affected by political concerns. Physicians could have a chance to affect those prices by putting pressure on legislation. An increase in the period considered would be very limited, however, due to the state budgets in crisis. Also, the payments are generally low making those patients not attractive to most physicians.

Ability of physicians to affect prices in the short run is subject to discussion. In this section we do not make an attempt to model this complicated process and assume a simple demand form. Differences across physicians are reflected in individual specific coefficients and implications of differential values for coefficients for our model are discussed at the end of this section.

Consider the physician as an individual maximizing her utility. Suppose that indirect utility is a function of income and leisure, and it is concave and increasing in both with a positive cross derivative. Let the demand function faced by physician i depend on her case load, n_i, and the aggregate case load of physicians that are in the same market, N_{m_i}:

$P_i = \alpha_i - \beta_i * N_{m_i} - \theta_i * n_i$

Note that each coefficient has a subscript i for the specific conditions that physician faces. For example if the physician's case load does not have any effect on the price, as would be the case if he were treating mainly Medicaid patients, then θ_i would be 0. The effect of competition is through the N that shows the number of patients that are treated by other physicians in the same market. Again, physicians could differ in the impact of competition on their practice and the coefficient β_i reflects these differences.

Each physician pays the malpractice liability insurance premium, M, that depends on the number of patients and there is a cost to treating patients that increases in the number of patients, that we denote by C. Leisure time available to the physician is also a concave decreasing function, h, of number of patients. The income available to physician i will be:

$I = (\alpha_i - \beta_i * N_{m_i} - \theta_i * n_i) * n_i - C(n_i) - M(n_i)$

and the utility function will be:

$U_i = U(I, l) = U((\alpha_i - \beta_i * N_{m_i} - \theta_i * n_i) * n_i - C(n_i) - M(n_i), h(n_i))$

Physician chooses n_i to maximize her indirect utility. The first order condition, then, is:

$U_1 * I'[(\alpha_i - \beta_i * N_{m_i} - 2 * \theta_i * n_i) - C' - M'] = U_2 * h'$

Note that marginal income from additional customer depends on coefficients of the demand function. Now consider an increase in malpractice premiums. The change could affect the case load in two ways. First is the income effect that would work through U1 and U2. Higher M would lead to lower I and as U is concave and its cross derivative is positive, U1 would be higher while U2 is lower. Second, depending on the change in M' there would be a direct effect through marginal income. We will first assume that M' stays the same. This would be the case if the insurance premiums were independent of the number of cases a physician treats. In that case income effect would lead the physician to take more customers assuming she continues the practice. The extent of the increase in case load would depend on the marginal return from additional customer and the marginal utility of leisure. Note that this is similar to a lump sum tax in public economics literature.

Next consider that M' is also affected by the crisis. Then the cost of treating the marginal patient would be higher and the physician would tend to decrease the workload. The outcome would depend on the balance between the direct and indirect effects.

For the malpractice liability there is some relation between the premiums and the case load but the relation is not one to one. For example, the rates change between part time and full time practices but they are not a linear function of number of patients. Therefore for the marginal patient it is not very likely that the premiums will change considerably. When big jumps are considered in case load, however, the premiums are likely to increase along with the case load.

3.2 Location choice

Following the discussion above denote the indirect utility of a physician in a given period, t, as a function of malpractice burden M, $U_t(M)$. To make the location choice, physician will compare discounted expected utility over the practice period at different locations. For the sake of simplicity we assume that indirect utility at time t from the next best alternative is U_{it}^A and the expected discounted indirect utility over the career span of the physician is V_{it}^A. Malpractice burden will be subject to shocks. While physician will be able to observe the shocks she will not know their duration and will assign a probability on duration. Each period the probability distribution will be adjusted using any new information available. Denote the probability at period t that the shock will last until period k by λ_k^t.

Let M_0 be the level of malpractice burden before the shock occurred and m the shock. Then, expected level of malpractice burden at period k will be:

$E_t(M_k) = M_0 + \lambda_k^t * m$

We assume that there is a cost to move to next best alternative, C, that depends on physician characteristics. For example, the cost is zero for a starting physician. Expected revenues from future periods are discounted at the rate of ρ. We will denote the career span left to the physician by T. We will assume that once the shock is over the malpractice burden will stay constant at M_0 for the rest of physician's career. We will also allow the physician to move only once. The results could be extended to the case when physician can move as many times as she desires.

Also note the expected utility from period k on, at the current location, assuming that the shock was not over in period k-1 by V_{ik}[4]. Then expected discounted utility from staying at the current location is:

$U(M_0 + m) + \rho * V_{it+1}$

If the physician were to move at once, when expected value of moving is positive, she would move when:

$U(M_0 + m) + \rho * V_{it+1} < U_{it}^A + \rho * V_{it+1}^A - C$

There is however an option value to waiting because of the uncertainty surrounding the duration of the crisis[5]. Waiting is informative in the sense that physician learns 1) whether the shock ended in following period, 2) updates the probability distribution based on new information if any. Additional information could make it more beneficial to stay and physician could forgo the benefits of moving now in order to make a more informed decision.

To illustrate the point let's compare the expected utilities of moving in period t with moving in period t+1.If the physician moves in period t, she will get:

$U_{it}^A + \rho * V_{it+1}^A - C$

Now let's look into the expected utility from waiting for one period. At period t+1 it could either be that the shock has reversed itself or it continues. If the former is the case then the person would stay in current location and would get:

[4] If the shock were over then expected discounted utility would simply be $\sum_{j=k}^{\overline{T}} \rho^{k-j+1} * U(M_0)$ following our assumption that the shock happens once.

[5] see Dixit and Pindyck (1994) for an in depth analysis of option value of waiting in investment decisions.

$$U(M_0 + m) + \sum_{k=t+1}^{\infty} \rho^k * U(M_0)$$

Otherwise at period t+1 she would either move or stay depending on the new probability distribution. For the sake of simplicity assume that the probability distribution stays the same and it does not pay to wait for one more period. The returns if the shock continues would be:

$$U(M_0 + m) + \rho * (V^A_{it+1} - C)$$

Therefore waiting for one period would have expected benefits of:

$$U(M_0 + m) + \lambda^t_{t+1} * \sum_{k=t+1}^{\infty} \rho^k * U(M_0) + (1 - \lambda^t_{t+1}) * \rho * (V^A_{it+1} - C)$$

Then the difference between moving in t and in t+1 would be:

$$U^A_{it} - U(M_0 + m) + \lambda^t_{t+1} * (\rho * V^A_{it+1} - \sum_{k=t+1}^{\infty} \rho^k * U(M_0)) + ((1 - \lambda^t_{t+1}) * \rho - 1) * C$$

So, by moving in period t+1 physician would carry the burden of higher premiums for one more period ($U^A_{it} - U(M_0 + m)$), but would save on costs if the shock reverses itself in the next period ($((1-\lambda^t_{t+1}) * \rho - 1) * C$). Also, as a results of our constraint that physician moves only once, if the shock reverses, she would have to live in alternative location even though the premiums are lower in original location ($\lambda^t_{t+1} * (\rho * V^A_{it+1} - \sum_{k=t+1}^{\infty} \rho^k * U(M_0))$). Note that without that assumption physician would still bear the costs of moving back should she decide to move back. The outcome would depend on the magnitude of these forces. When the cost of moving is low or the burden of shock is high to move in time t would be preferred.

3.3 Discussion

As shown above the outcome of the crisis would depend on the parameters of the model that reflect differences across physicians. Characteristics of health sector and differences across physicians could lead to differences in reaction.

Physicians do not have much influence on prices because they face insurance companies that are similar to monopsonists and government that has a specific way of adjusting the prices. Most of the adjustment then has to be through the case load but not price. The number of patients depends on many factors. A crucial one is the potential number of patients. While the patient's choice of physician is a complicated process, it is mainly made through recommendations [find reference]. Therefore physician's location, reputation, professional relations, and seniority are factors that determines her appeal to the patients. Differences across physicians in those characteristics would determine how well a physician

could cope with the crisis.

While we are not able to observe most of those characteristics we have information on other characteristics that might be correlated with them. We can differentiate between new and established physicians. New physicians would have a harder time to access patients. As reported in [reference] most new physicians start the practice by joining group practices. Therefore older physicians could block the entry to the market by reducing hiring for their practice groups.

We also have information on some characteristics that could signal the quality of the physician. We know which medical school they are graduated from or whether they are citizen or not. These characteristics could be important in two ways. First they could affect the market for the physician in question. Credentials of the physician could be important to appeal patients. Second, they could affect the susceptibility of physician to malpractice cases. Waters et.al. (2003) finds that physicians from some medical schools are more likely to be sued than others. These two factors would provide advantages to a physician with better credentials over the others in dealing with malpractice crisis. Those with better credentials, however, could also have an easier time to get the jobs at low risk states leaving the crisis states to those with worse credentials as the claimant of residual demand.

Effects of uncertainty would similarly differ across physicians. New physicians with low relocation costs may not find option value of waiting attractive while the established physicians could care more. Also those physicians who are better in adapting to the new conditions because they could adjust their case load easier, would be more likely to wait for longer periods.

As a result we would make the following predictions as to the effects of the crisis. First, for established physicians we would expect little change in location choice. They would be adjusting the case load to better fit the conditions. New physicians would be affected in two ways. First they would prefer to avoid the crisis regions because they would have difficulties to adopt as well as older ones, and they would have lower costs of relocating. Second their entry would be blocked by older ones if they try to capture a larger share of the market.

The choice for residency location is more complicated. Malpractice insurance premiums are paid by the residency program. Physician candidates could still be concerned about the malpractice liability because they tend to practice at the location of residency [reference].

4 Data and empirical model:

In this section we will go through the data sets that we will be using and describe estimation models.

4.1 Malpractice pressure

The recent malpractice liability crisis has been characterized by increasing premiums, difficulties in access to insurance and increasing number of claims and payments. While these measures are highly correlated, the relation is not necessarily one to one. Due to regulations, in some states, the premiums were stable but access to insurance was more restricted because major insurers left the state. Table 1 lists the malpractice burden variables that we are using by state and table 2 presents the correlations across these variables [comments]. The variables are 1) a dummy that shows whether a state is in crisis or not according to a classification by American Medical Association (AMA), 2) change in malpractice premiums, 3) change in number of malpractice cases per million people, 4) total payments in those cases.

Classification of states as in crisis or not is from AMA. The classification is based on... To measure the change in premiums we will be using data from Medical Liability Monitor Survey. Data is collected through a survey sent to insurance companies. Each company reports premiums they charge by varying geographical areas. While most data are statewide, for larger states companies often report county based premiums. When this is the case we use a population weighted average of premiums.

As the survey is voluntary we have information for only a select group of insurers and that information is not available for all years. For that reason we are able to use data from 1997 on even though our data set goes back to 1993. For each state we consider only the firms that have been reporting all the years from 1997 to 2002. As many of the reporting insurance companies are regional rather than national our data is composed of premiums from different companies.

A major setback about the use of data is that there is only one number reported per region. In reality it is known that there is variation across physicians located at the same place, in the premiums they pay even though this is not to the extent we observe in other type of insurances. The number reported correspond to the highest, lowest or standard premium before any discounts (In some instances companies report both highest and lowest premiums but this is rare). It has been reported, however, that in many states as the insurance companies go out of market and remaining ones try to dress their finances up, those physicians with a worse record of malpractice liability face harsher conditions. For

example in New York our data shows little variation in premiums and ??? reports that only %10 percent of physicians has been subject to increasing premiums. A Times front page story describes how an Illinois physician faced huge increase in premiums. As such our data may not be reflecting the change faced by some physicians and if those physicians move from one state to the other our estimation will not be accurate.

In order to measure the effect of premiums for those who are more likely to bear burden of high premiums we make assumptions on who those people could be. A GAO report states that the major reason behind increasing premiums is the losses incurred by insurance companies in malpractice cases. If that is the case we would expect the companies to use higher rates in those states where the malpractice pressure is higher. At such places insurance companies would be under a greater financial pressure and therefore would be more eager to put pressure on physicians. We use three additional variables to capture the malpractice environment: presence of caps on malpractice awards [work in progress], number of claims, and average awards.

4.2 Dependent variables:

We will be using data sets describing the location of physicians at different stages of their practice. There is no consensus in the literature when the initial location choice done. It could go as early as the medical school or it could be determined after trying to practice a few location. We will analyze two potential stages where the decision could have been done: residency and after residency.

Our data shows a strong correlation between the state of residency and the state of practice. It is also reported in [reference] that most graduates practice at the residency location. Residency data set reports the number of positions offered and filled per residential programs. [info on residency match program]. Those numbers could be affected by the crisis in two ways. As the malpractice premium is generally paid by the programs, it is likely that those programs will look for a smaller number of residents as the malpractice pressure goes up. Second, if the residency place is likely to be practice location we would expect candidates to avoid crisis states if they expect the crisis to last long. We believe that thee number of positions open will show the behavior of graduate programs while the number of filled positions will show a combination of programs' and students' reaction.

We have a rich data set on the location choice after residency. Graduate Medical Education Survey

gives a detailed account of every physician finishing a residency program in US. In the data we are able to observe whether the graduate started to practice and if so which location he started to practice. Data also includes several properties of graduates such as sex, age, medical school, ethnicity, citizenship etc. Using the information on medical school and medical school rankings we were able to rank the medical school the graduate has completed. The ranking of medical school and citizenship status will be the variables that we will be using as indicators of quality of physicians. We will assume that there is significant differences between grads from ranked and non-ranked schools as well as us born and foreign grads in their appeal to the patients as well as in their susceptibility to malpractice pressures. For those with higher ranking of medical school or for the citizens it will be easier to capture demand and also they will be less vulnerable to malpractice pressure.

While the data on location choice of new physicians is rich it has one major defect. Due to a change in survey format (a switch from paper based survey to an internet based) in the year 2000 the answers from that year are largely lacking and in many cases inconsistent. This is also reflected in our results.

For the effect of the premiums on established physicians we will first look at the change in total number of physicians. Data on the number of physicians is obtained from AMA Physician Masterfile. The data set collects information on physician location through several channels including state licenses, board certifications etc. The data is supported by four yearly surveys. In this work we will be using the total number of physicians by state from 1997 to 2002.

Accuracy of AMA Physician Masterfile is subject to doubts. As the surveys are done every four years data could miss some of the physicians who have left the practice. It also does not tell what kind of practice physician is performing. For example an OB/Gyn could be seeing patients but not performing delivery because of high premiums attached to delivery. Moreover the numbers do not include family physicians who used to perform deliveries but have stopped doing so because of the premiums. As a result of all these factors data is likely to underestimate the effect of the crisis.

As an alternative we are using patient level data from Florida to look into practices of physicians in that state. Florida has been hit by the crisis. As seen in table 1 premiums increased on average by \$12,000 and even more in some parts of the state. Data is reported by hospitals and contain information on the case including a code for the operating physician. Using this information we are able to tell the number of physicians and how their case load changes. By matching this information with other data

we are able to learn more about physician characteristics. An interesting question that we can answer, then, is the identity of the quitters. Who left the practice who did not.

4.3 Methods

Physician location choice is a complicated process that depends on the characteristics of location as well as the physician. We will assume that we can capture the process using a linear functional form where the control variables are the population density, HMO penetration rate, income level, number of potential patients and education level. Means and standard errors of these variables are provided in table 3. We also show, in the same table, statistics for states in crisis and not. States that are in crisis and not are similar in all but one variable, population density.

We assume that effect of all variables is assumed to stay constant over time, except for the effect of the malpractice crisis. To see how this effect changes over time we interact the malpractice crisis variable with year dummies. We expect the interaction to have no effect on location choice in late 1990s when the crisis did not start yet but to become more significant after that.[more compact functional form]

For those data sets where we have individual level observations of location choice we use a conditional logit model. Let $J = \{1, 2, 3, ..., 48\}$ be the set of available choices. We assume that physician's indirect utility from practicing in state j takes the following additive form:

$$U_{ij} = m_j * \theta + \sum_{t=1997}^{2002} m_j * t * \pi_t + x_j * \beta + \varepsilon_i$$

where m is the malpractice burden and t is dummy for the year. Physician will choose the location that brings highest utility level. Let y_{ij} take value one when physician i chooses to locate in location j and 0 otherwise. Assuming an extreme value distribution on epsilon the probability of choosing location j will be:

$$P(y_{ij} = 1) = \frac{\exp(m_j * \theta + \sum_{t=1997}^{2002} m_j * t * \pi_t + x_j * \beta)}{\sum_{k \in J} \exp(m_k * \theta + \sum_{t=1997}^{2002} m_k * t * \pi_t + x_k * \beta)}$$

Coefficients will be found by maximizing the log likelihood function. While our focus were on diversity of the physicians conditional logit model will provide the mean effect of the crisis. To get a distribution of the effect over the physician population we will be using random coefficients model [work in progress].

When we have aggregate numbers but not individual level observations we use linear regressions corrected for dependence of error terms across time. In our regressions we will use number of physicians

per 100,000 people in a state at a given year as dependent variable.

5 Results:

Our results show that physicians at different levels have been affected differently from the crisis. For the established physicians the impact has been small. As noted above this data set may not be up to date and it would be more cautious to see the results from the analysis of patient level data before coming to any conclusion. For new physicians, however, the impact was stronger, started in 1999 and continued in the following years. In the following sections we will go into the details of our findings.

5.1 Total number of physicians:

We will start our analysis of the results with the total number of physicians. While this reflects both the established and new physicians, as the number of new physicians is small [numbers] we expect it to reflect more the behavior of established physicians than the new ones.

Table 4 presents the results for regression of number of physicians per 100000 population on population density, median income, HMO penetration and number of births along with the variables that measure the extent of malpractice crisis. Columns one to four present the results when the malpractice pressure is measured by crisis, premium, number of cases and total payments respectively.

The results for our control variables are mostly as expected. The physician concentration increases with the density and income significantly. The effect of number of births and number of college graduates is in the right direction but insignificant. HMO penetration increases the number of physicians but not significantly. The reason for positive relation could be because it could be signalling the change in unemployment. It should be noted, however, that since we do not use fixed effects coefficients could be biased.

The coefficient for malpractice crisis variable is always positive significant but this does not mean much because we do not use fixed state effects. What we are interested is the interaction of that variable with time dummies. If there is a negative impact of the crisis on the number of physicians we would expect to see that in the interaction variables.

When we use the crisis dummy as the malpractice pressure variable (column 1) we see that the effect is strongest in 2000 but disappears by 2002. With the other pressure variables, however, the effect of

the pressure lasts longer. In none of the cases the coefficient is significant. The effect is too weak.

These results support our hypothesis that given the uncertainty around the duration of the crisis physicians would choose to wait and would find ways to adjust. The result could as well be due to deficiencies in the data that we have mentioned above. Analysis of data from Florida inpatient records is expected to bring more reliable results.

A reason for the drop in the effect of the malpractice pressure as measured with the crisis dummy could be the change in the legislation. Florida, Ohio and Texas have passed laws capping malpractice awards in 2003. Physicians could have expected such a change and have reduce their movement in 2002. To look further in the effect of the expectations we interact a dummy for these states with the effect in 2001 and 2002 to see whether the physician behavior has been different in those states. [work in progress]

[More on the magnitude of the effects and interpretation]

5.2 New physician

We are looking at two stages where the location choice for the practice state might have been done. First we will look at the number of positions opened and filled for residency programs. The number of positions open will give information on the attitude of the residency programs while the filled positions will tell about the choice of physician candidates. Second we will consider the location choice after the residency. Our data set will also allow us to inquire whether physicians differ in their choices according to their quality as measured by the ranking of the medical school they have graduated..

5.2.1 Residency place

The analysis of open positions for residency is presented in table 5. Similar to the results with the total number of physicians none of the interaction variables is significant. Again the effect of malpractice variables peaks in 2000 to go down in the following years. The results are similar with all four measures of malpractice pressure variable.

The number of filled positions, however, shows a different result in terms of significance. The coefficient is significant when we use the crisis variable in 1999 to 2001. Again the effect is strongest in 2000 going down after that time. The results are similar, again, in terms of the trend and magnitude

for other malpractice variables but it is not significant.

[More on the magnitude of the effects and interpretation]

5.2.2 After residency

The practice location after residency is where we get strongest results. It is presented in two tables. The first displays the effects of crisis on average physician while in the second we differentiate between those physicians who graduated from ranked schools versus those who are not.

In table 7 we see negative coefficients for the interaction of malpractice variables with time dummies. If we disregard the results for year 2000, the coefficient is about the same value in suspected crisis years– 1999 to 2002– and close to zero in 1998. The result in 2000 is lower than the other years but this is most likely due to the change in survey format in that year. [results excluding year 2000-work in progress]. We observe similar numbers for the other variables too.

In table 8 we interact the malpractice pressure variables with a dummy that shows either the medical school of the graduate has been ranked or not. This is expected to show the quality of the graduate. Here we observe the change in physician supply only for those graduates whose medical school is not ranked and not for other graduates. Coefficient for non-ranked school graduates is negative and significant in a few cases while the coefficients for ranked school graduates is close to zero and not significant.

[More on the magnitude of the effects and interpretation]

6 Conclusion

In this paper we measured the impact of the recent crisis on physician supply. We first modeled physician reaction to the crisis in terms of changes in the practice style and location choices. We emphasized uncertainty that surrounds the duration of the crisis. Our model showed that physicians could tend to increase their workload to the extent which the increase in malpractice premiums are independent of the case load. We have also found that uncertainty could delay relocation of physicians especially if moving costs are large.

Empirical work considered several data sets to reflect differences across physicians. We found that the total number of physicians did not change considerably. The effect has peaked in 2000 but has never been significant. Residency programs in crisis states had difficulties in filling up their programs.

The impact on new physicians depended on the quality of the physician. While those with a medical education from a ranked school were not affected by the crisis, others chose to (or had to) locate in states that are not in crisis.

More work is needed to support the findings on the total number of physicians. The inpatient level data from Florida could help to verify the results and to explain how physicians dealt with the increasing premiums. Data on prices could also be very useful to see whether physicians have been able to affect prices and to assess the additional burden this has put on patients.

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Table 1: Malpractice crisis variables

	crisis	premiums	claims	payments	change in number of physicians
Alabama	0	-3277	0.67	2299	0.61
Arizona	0	-5795	3.67	1965	-0.18
Arkansas	1	4404	2.00	2622	0.21
California	0	-2360	-13.00	5591	0.07
Colorado	0	-1794	4.33	1287	0.00
Connecticut	1	15842	0.33	3409	0.06
Delaware	0	19244	1.67	183	1.36
Florida	1	12565	21.00	5894	-0.20
Georgia	1	-1016	4.67	4408	0.37
Idaho	0	-1395	-0.67	-628	0.64
Illinois	1	8921	-20.00	5453	0.20
Indiana	0	1010	-1.33	-1177	0.49
Iowa	0	3499	1.67	-9	0.28
Kansas	0	3838	-3.67	-560	0.35
Kentucky	1	7032	9.00	6710	0.42
Louisiana	0	-1061	0.33	-964	0.52
Maine	0	-1562	-0.67	672	1.16
Maryland	0	1133	7.33	4407	-0.07
Massachusetts	0	11041	6.00	9083	0.27
Michigan	0	3447	-2.00	1495	0.18
Minnesota	0	-1331	-1.33	1268	0.48
Mississippi	1	200	0.67	185	0.88
Missouri	1	1487	5.00	777	0.29
Montana	0	-2595	-1.00	868	0.92
Nebraska	0	-785	4.67	2458	0.53
Nevada	1	8424	1.00	695	0.07
New Hampshire	0	1421	-3.00	-911	0.22
New Jersey	1	-4098	28.67	20800	0.35
New Mexico	0	899	4.00	453	-0.35
New York	1	-6213	-12.67	12800	0.08
North Carolina	1	1599	2.67	389	0.06
North Dakota	0	-1958	0.67	603	-0.99
Ohio	1	6750	4.00	8422	0.26
Oklahoma	0	-2557	-3.33	-1168	-0.07
Oregon	1	3526	3.33	6130	0.93
Pennsylvania	1	13575	30.67	21200	0.28
Rhode Island	0	-3124	0.67	1780	0.51
South Carolina	0	3431	5.33	2806	0.87
South Dakota	0	-827	0.67	256	0.42
Tennessee	0	7049	-4.33	-1938	0.03
Texas	1	3257	-5.00	12100	0.20
Utah	0	7468	2.00	2215	-0.33
Vermont	0	-2038	-2.67	-574	1.18
Virginia	0	4219	7.67	4999	0.47
Washington	1	5248	-1.00	2943	0.49
West Virginia	1	4917	5.00	394	-0.20
Wisconsin	0	-1983	3.33	3352	0.09
Wyoming	0	719	0.00	-22	-0.09

Table 2: Correlation between malpractice variables and number of physicians

	crisis	premiums	claims	payments	no. of physicians
crisis	0.24	0.32	0.22	0.50	-0.06
premiums	0.32	31074468	0.22	0.15	0.03
claims	0.22	0.22	70.08	0.51	-0.04
payments	0.50	0.15	0.51	3967	-0.05
no. of physicians	-0.06	0.03	-0.04	-0.05	0.19

Table 3: Summary Statistics

	1997			2002		
	all	**crisis**	**no crisis**	**all**	**crisis**	**no crisis**
birth ratio	14.05	14.13	14.01	13.61	13.65	13.59
	(1.72)	(1.34)	(1.94)	(1.74)	(1.51)	(1.90)
college grads	23.06	22.43	23.44	25.99	25.05	26.55
	(4.30)	(4.09)	(4.44)	(4.61)	(4.28)	(4.78)
hmo penetration	0.26	0.28	0.25	0.27	0.28	0.27
	(0.14)	(0.13)	(0.15)	(0.13)	(0.11)	(0.14)
median income	36.37	36.42	36.35	42.11	41.09	42.73
	(5.22)	(5.76)	(4.96)	(6.46)	(6.63)	(6.39)
population density	180.84	228.26	152.39	196.23	246.57	166.02
	(248.57)	(275.11)	(231.37)	(266.96)	(294.14)	(249.54)

Table 4: regression of number of physicians on malpractice pressure variables

	Crisis	premiums	claims	payments
crisis	**0.90 ***	**0.07**	**-0.21**	**0.05**
	(0.45)	(0.51)	(0.15)	(0.05)
crisis*year=1999	**-0.01**	**-0.05**	**0.02**	**0.00**
	(0.09)	(0.10)	(0.04)	(0.01)
crisis*year=2000	**-0.24**	**-0.12**	**-0.05**	**-0.02**
	(0.17)	(0.20)	(0.07)	(0.02)
crisis*year=2001	**-0.13**	**-0.12**	**-0.09**	**-0.02**
	(0.19)	(0.21)	(0.08)	(0.02)
crisis*year=2002	**0.04**	**-0.09**	**-0.09**	**-0.01**
	(0.24)	(0.21)	(0.09)	(0.02)
birth ratio	0.02	0.03	0.06	0.03
	(0.08)	(0.08)	(0.09)	(0.08)
college grads	2.05	2.25	2.37 *	2.04
	(1.33)	(1.60)	(1.27)	(1.41)
hmo penetration	0.02	0.02	0.02	0.02
	(0.05)	(0.05)	(0.05)	(0.05)
median income	0.11 *	0.09	0.07	0.09
	(0.06)	(0.06)	(0.06)	(0.06)
population density	0.01 ***	0.01 ***	0.01 ***	0.01
	(0.00)	(0.00)	(0.00)	(0.00)
_cons	5.30 ***	5.95 ***	5.96 ***	5.98
	(1.64)	(1.63)	(1.72)	(1.63)

Table 5: regression of open positions for residency programs on malpractice pressure variables

	Crisis	premiums	claims	payments
crisis	**0.059**	**0.012**	**-0.013**	**0.003**
	(0.05)	(0.05)	(0.02)	(0.01)
crisis*year=1999	**-0.014**	**0.000**	**-0.009**	**-0.002**
	(0.02)	(0.02)	(0.01)	(0.00)
crisis*year=2000	**-0.028**	**-0.008**	**-0.010**	**-0.003**
	(0.02)	(0.02)	(0.01)	(0.00)
crisis*year=2001	**-0.025**	**-0.004**	**-0.009**	**-0.002**
	(0.02)	(0.02)	(0.01)	(0.00)
crisis*year=2002	**-0.013**	**-0.001**	**-0.008**	**-0.001**
	(0.02)	(0.02)	(0.01)	(0.00)
birth ratio	-0.01	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
college grads	0.00	0.63 ***	0.66 ***	0.64
	(0.01)	(0.21)	(0.20)	(0.20)
hmo penetration	0.63 ***	-0.01	-0.01	-0.01
	(0.19)	(0.01)	(0.01)	(0.01)
median income	-0.01	0.00	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
population density	0.00 **	0.00 ***	0.00 ***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
_cons	0.44 **	0.47 **	0.48 **	0.48
	(0.20)	(0.21)	(0.22)	(0.21)

Table 6: regression of filled positions for residency programs on malpractice pressure variables

	Crisis	premiums	claims	payments
crisis	**0.06**	**0.16**	**-0.01**	**0.003**
	(0.05)	(0.45)	(0.02)	(0.01)
crisis*year=1999	**-0.03 ***	**-0.05**	**-0.02 *****	**-0.004**
	(0.02)	(0.22)	(0.01)	(0.00)
crisis*year=2000	**-0.05 *****	**-0.18**	**-0.01**	**-0.005**
	(0.02)	(0.22)	(0.01)	(0.00)
crisis*year=2001	**-0.03 ***	**-0.07**	**-0.01**	**-0.005**
	(0.02)	(0.25)	(0.01)	(0.00)
crisis*year=2002	**-0.03**	**-0.14**	**-0.02 ****	**-0.002**
	(0.02)	(0.25)	(0.01)	(0.00)
birth ratio	-0.01	-0.01	0.00	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
college grads	0.00	0.62 ***	0.65 ***	0.64
	(0.01)	(0.20)	(0.19)	(0.19)
hmo penetration	0.62 ***	-0.01	-0.01	-0.01
	(0.18)	(0.00)	(0.00)	(0.00)
median income	-0.01	0.00	0.00	0.00
	(0.00)	(0.01)	(0.01)	(0.01)
population density	0.00 **	0.00 **	0.00 ***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
_cons	0.35 **	0.38 **	0.38 **	0.38
	(0.17)	(0.18)	(0.18)	(0.18)

Table 7: results from the conditional logit analysis of new physician location choice

	Crisis	premiums	claims	payments
crisis	**0.65 *** **	**0.000**	**0.00**	**0.04**
	(0.11)	(0.01)	(0.04)	(0.01)
crisis*year=1998	**-0.04**	**-0.003**	**-0.11**	**-0.02**
	(0.31)	(0.03)	(0.14)	(0.03)
crisis*year=1999	**-0.51**	**-0.05**	**-0.25**	**-0.02**
	(0.31)	(0.03)	(0.14)	(0.03)
crisis*year=2000	**-0.17**	**-0.02**	**-0.01**	**0.00**
	(0.32)	(0.03)	(0.14)	(0.03)
crisis*year=2001	**-0.50**	**-0.03**	**-0.28 ***	**-0.01**
	(0.31)	(0.03)	(0.14)	(0.03)
crisis*year=2002	**-0.46**	**-0.05**	**-0.19**	**-0.03**
	(0.32)	(0.03)	(0.14)	(0.03)
birth ratio	0.14 ***	0.14 ***	0.15 ***	0.14
	(0.01)	(0.01)	(0.01)	(0.01)
college grads	0.01	-0.01 ***	-0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
hmo penetration	1.07 ***	1.02 ***	0.96 ***	0.65
	(0.22)	(0.22)	(0.22)	(0.22)
median income	0.00	0.01	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
population density	0.00	0.00 **	0.00 ***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
residency place	3.79 ***	3.92 ***	3.90 ***	3.79
	(0.04)	(0.04)	(0.04)	(0.04)

Table 8: results from the conditional logit analysis of new physician location choice (with ranked school interaction)

	Crisis	premiums	claims	payments
crisis	**0.74** ***	**0.01**	**-0.03**	**0.05**
	(0.14)	(0.01)	(0.05)	(0.01)
crisis*year=1998	**-0.10**	**-0.03**	**-0.10**	**-0.02**
	(0.39)	(0.03)	(0.17)	(0.03)
crisis*year=1999	**-0.60**	**-0.08** **	**-0.38** **	**-0.04**
	(0.38)	(0.04)	(0.17)	(0.03)
crisis*year=2000	**0.15**	**-0.05**	**0.04**	**0.01**
	(0.40)	(0.04)	(0.17)	(0.03)
crisis*year=2001	**-0.70** *	**-0.06**	**-0.19**	**-0.01**
	(0.38)	(0.04)	(0.17)	(0.03)
crisis*year=2002	**-0.66**	**-0.08** **	**-0.25**	**-0.05**
	(0.39)	(0.04)	(0.17)	(0.03)
crisis*ranked school	**-0.26**	**-0.04**	**0.05**	**-0.03**
	(0.24)	(0.02)	(0.09)	(0.02)
crisis*rs*year=1998	**-0.40**	**0.00**	**0.15**	**-0.05**
	(0.67)	(0.07)	(0.31)	(0.06)
crisis*rs*year=1999	**-0.29**	**0.00**	**0.66** **	**0.00**
	(0.67)	(0.07)	(0.31)	(0.06)
crisis*rs*year=2000	**-1.45** ***	**0.01**	**0.02**	**-0.09**
	(0.67)	(0.07)	(0.31)	(0.06)
crisis*rs*year=2001	**0.07**	**-0.01**	**-0.10**	**-0.05**
	(0.68)	(0.07)	(0.31)	(0.06)
crisis*rs*year=2002	**0.11**	**-0.02**	**0.44**	**0.01**
	(0.68)	(0.07)	(0.32)	(0.06)
birth ratio	0.14 ***	0.14 ***	0.15 ***	0.14
	(0.01)	(0.01)	(0.01)	(0.01)
college grads	0.01	-0.01	-0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
hmo penetration	1.07 ***	1.02 ***	0.95 ***	0.66
	(0.22)	(0.22)	(0.22)	(0.22)
median income	0.00	0.00	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
population density	0.00 **	0.00 **	0.00 **	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
residency place	3.79 ***	3.92 ***	3.90 ***	3.79
	(0.04)	(0.04)	(0.04)	(0.04)