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ABSTRACT

Spatial inequalities in access to physicians is a long-standing problem in the US, and it may be an important underlying cause of SES-related and racial/ethnic disparities in health outcomes. One important factor underlying spatial inequalities may be the enactment of state-level malpractice reforms, which could affect physician supply to a state, and/or lead to sorting among physicians across states along characteristics such as physician quality. In this study, we test whether state-level malpractice laws affect new physicians' location decisions and sorting of physicians by quality measures across states. We use data from the New York State (NYS) Residents' Exit Survey, which includes all exiting medical residents from hospitals in NYS, and includes the practice locations these new physicians have chosen. We focus on two malpractice reforms – caps on noneconomic damages and caps on punitive damages. Our findings suggest that both types of reforms are associated with an increased probability of new physicians locating in the state that passed the reform, but only the caps on noneconomic damages are statistically significant at conventional levels. Effects of the laws are stronger for physicians in specialties which tend to face the highest risk of malpractice awards, while the opposite is true for physicians in specialties with the lowest risk of malpractice awards, as well as for osteopathic physicians. Physicians entering solo practice and partnerships respond more to damage cap laws than physicians entering group practices, hospital-based practices and other practice settings. While we do not find that median MCAT scores in the medical schools attended (among physicians from medical schools in New York State (NYS)) interact with the effects of the laws, we do find that US citizens attending foreign medical schools, as well as international medical graduates more generally, respond more to damage caps laws compared to physicians trained only in the US. If we consider the degree of selectivity of the medical school to be a measure of physician ability, this finding may suggest that damage cap laws influence location choices more among lower-ability physicians.

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1. Introduction and Background

Since the 1970's, almost all states in the US have passed tort reforms intended to reduce unnecessary litigation and excessive settlements related to medical malpractice. Some of the most common and widely studied reforms include: (1) caps on damages, which limit the dollar amount of damages paid to successful plaintiffs in malpractice suits; (2) joint and several liability reforms, which stipulate that a defendant must be liable for a certain percentage of the harm caused to another party before bearing 100 percent of damage costs; and (3) collateral source rule reform, which modifies the law mandating that amounts that the plaintiff obtains from other sources not be used as evidence in the trial (Currie & MacLeod, 2008). Some of these state-level reforms appear to have reduced the "malpractice pressure" that physicians face. Caps on damages, for example, are associated with declines in the number of lawsuits,[1] reductions in the value of awards made, and decreases in physicians' malpractice premiums (Avraham, 2007; Baicker & Chandra, 2005; Williams & Mello, 2006; Danzon, 1986). The concept of "malpractice pressure," however, includes not only malpractice premiums (from which many physicians are largely insulated due to working in group practices) but also psychic costs, time costs, and reputational harm (Currie & MacLeod, 2008). Thus, if tort reforms reduce the likelihood of lawsuits against physicians, these reforms may affect physician behaviors immediately, even if changes in malpractice premiums are not the primary mechanism.

If state-level malpractice reforms are successful in reducing malpractice pressure on physicians, there are likely to be two kinds of effects. First, physicians may respond by taking less care in treating patients, since their malpractice liability is reduced (moral hazard) (Kessler & McClellan, 1996; Currie & MacLeod, 2008). Second, enactment of these reforms may affect physician supply to a state, and/or lead to sorting among physicians across states, with physicians with certain characteristics choosing to

[1] Patients may be less likely to file malpractice claims in states that have passed reforms, since these claims are less likely to be successful and yield worthwhile payouts.

practice in states with particular malpractice environments. In this paper, we focus on this second possible effect – the effect of malpractice reforms on physicians' location choices.

There is mixed evidence that state malpractice reforms affect the aggregate supply of physicians in a state. Kessler et al. (2005) use state-level data from 1985 to 2001 and find that "direct" malpractice reforms (defined as passage of any law capping damage awards, removing punitive damages or mandatory pre-judgment interest, or reforming the collateral source rule) are associated with greater growth in the aggregate supply of physicians. They report stronger effects on physicians more likely to face malpractice pressure, including physicians not working in group practices and physicians in specialties with high malpractice premiums. Other studies find that the effects of malpractice reforms on physician labor supply tend to be concentrated among physicians who, based on their specialty and location, may face the greatest malpractice pressure. Klick & Stratmann (2007), for example, using state-level data from 1980-2001, find that caps on damages are associated with increases in the supply of physicians working in specialties facing the highest average medical malpractice award per doctor. Matsa (2007), using state-level data from 1970-2000, reports that caps on damages increase the supply of specialist physicians working in rural areas. Finally, Chou & Lo Sasso (2009), using data on graduating residents from New York State from 1998-2003, find that new surgeons tend to locate in states with laws that cap malpractice damages, but this is not true for primary care physicians and OB/GYNs.

One recent paper focuses on the idea that state malpractice reforms may attract physicians who are the most likely to commit malpractice. Lieber (2014) points out that the distribution of paid malpractice claims is highly skewed, with the majority of physicians who had at least one malpractice claim in a 13-year period paying only one claim over that entire period. Using county-level data from the 1993, 1998, and 2004 releases of the US DHHS Area Health Resource File (AHRF), Lieber (2014) finds that when a neighboring state enacts a law placing caps on noneconomic damages there is both a 4 percent fall in the supply of physicians, as well as a 4 percent decline in the state's malpractice rate. He

uses variation in neighboring states' policies (rather than states' own policies) to identify the effect of malpractice reforms on physician supply because the law changes in physicians' own states can induce changes in physicians' propensity to commit malpractice (moral hazard) as well as in the incentives of patients of file malpractice claims, both of which will affect a state's malpractice rate. By focusing on the effects of a neighboring state's malpractice reforms, one can isolate the effect on the malpractice rate induced specifically by physician sorting. In sum, the findings in Lieber (2014) support an adverse selection story, in which physicians who are likely to commit malpractice are induced to move to reformed malpractice environments.

In this study, we test whether state-level malpractice laws affect new physicians' location decisions. Like Chou & Lo Sasso (2009), we use data from the New York State (NYS) Residents' Exit Survey, which includes all exiting medical residents from hospitals in NYS and includes the zip codes of the practice locations these new physicians have chosen. We consider the effects of state malpractice laws and local market characteristics, as well as interaction terms between individual characteristics and these variables, on location choices. These interaction terms allow us to test, to some extent, whether state malpractice reforms affect the types of physicians who chose to practice in those locations. We build on previous work, including Chou & Lo Sasso (2009) and Lieber (2014), by using more recent data (1998-2012), which allow us to consider some of the most recent malpractice reforms; and by focusing on how factors such as physician specialty, practice size, and ability interact with malpractice laws to affect location choices.

In this work, we focus on two malpractice reforms -- caps on noneconomic damages and caps on punitive damages. Caps on noneconomic damages are limits on damage awards for pain, suffering, and other nonpecuniary injuries. Caps on punitive damages are limits on damage awards that are granted to punish the defendant. Our findings suggest that both types of reforms are associated with an increased probability of new physicians locating in the state that passed the reform, but only the caps on noneconomic damages are statistically significant at conventional levels. When we consider interactions

between damage cap laws and physician characteristics, an intuitive pattern of findings emerges. Effects of the laws are stronger for physicians in specialties which tend to face the highest risk of malpractice awards, while the opposite is true for physicians in specialties with the lowest risk of malpractice awards, as well as for osteopathic physicians. Physicians entering solo practice and partnerships respond more to damage cap laws than physicians entering group practices, hospital-based practices and other practice settings. While we do not find that median MCAT scores in the medical schools attended (among physicians from medical schools in New York State (NYS)) interact with the effects of the laws, we do find that US citizens attending foreign medical schools, as well as international medical graduates more generally, respond more to damage caps laws compared to physicians trained only in the US. If we consider the degree of selectivity of the medical school to be a measure of physician ability, this finding may suggest that damage cap laws tend to influence location choices more among lower-ability physicians.

2. Theoretical Motivation

We begin with the following observations on the malpractice environment facing physicians and health care consumers. Physicians commonly purchase malpractice insurance, which because it is only weakly experience-rated (Sloan, 1990) insulates them from the immediate costs due to malpractice claims. Nonetheless, a malpractice suit can cause the physician emotional stress and consume her time, and importantly if it leads to an adverse judgment can damage her reputation, reducing her future earnings and labor market opportunities. But malpractice judgments appear to have a strong random component--that is, their likelihood may have little to do with physician actions. According to one influential study based on a close reading of medical case files, actual medical negligence rarely leads to a malpractice claim and most judgments that result from claims are not justified on the basis of the medicine practiced (Harvard Medical Practice Study, 1990). If malpractice suits and judgments are largely divorced from actual physician behavior, as this evidence suggests, then consumers should have

no additional confidence in the quality of care in a malpractice-friendly environment. Moreover, less than half of any judgment accrues to the plaintiff; most of an award is consumed by lawyer fees and other transaction costs (see the citations in Kessler, 2011, including Studdert et al, 2006).

Reform and the number of physicians

What therefore is the effect of malpractice reform in a state--taken to mean the increased difficulty in initiating a malpractice suit and reduction in potential malpractice awards--on the state's physician population? Malpractice reform should reduce malpractice insurance premiums, uninsured costs, and the variance (risk) in physician utility, thus shifting out the physician supply curve in the reforming state. Malpractice reform may, however, have countervailing effects on consumer demand for health care services. From the perspective of the consumer, malpractice reform increases her difficulty filing a suit, and reduces the odds and size of an award. Nonetheless, if as the evidence suggests, less than half of the award from a judgment accrues to the patient and the consumer does not see the malpractice system disciplining physicians into delivering higher quality health care, then malpractice reform should have a smaller effect on consumer demand for physicians' services compared to its effect on supply. Indeed, there is evidence that malpractice motivates physicians to practice defensive medicine (Kessler and McClellan, 1996, 2002a, and 2002b). A perception that physicians are likely to prescribe unnecessary treatment in a malpractice-friendly state may lead consumers to view the services they receive more favorably after reform. If the noted observations are accurate then, the forces shifting physician supply out dominate the forces shifting demand in, and reform will attract physicians, including new physicians, to the state, everything else equal.

Specialties and the supply effect

In some specialties, malpractice claims and judgments are common, in others claims are rare.

We would expect the supply effect of reform to be greatest in specialties where the incidence of malpractice claims is especially high. Kessler et al. 2005 finds that in some of the highest malpractice-premium specialties greater than average supply effects with reform. Malpractice reform may also expand the types of services offered. Where malpractice pressure is high, the expected malpractice costs and utility risk for some specialties may be such that the surplus generated by employment in the specialties are insufficient to cover physicians' outside options. These specialties will not emerge except in an environment where malpractice is curtailed. Evidence that obstetricians for example have ceased offering certain medical services in response to malpractice pressure is consistent with this (see the references cited in footnote 4 of Rolph, 1991). Thus, reform will attract physicians, including new physicians, disproportionately to specialties with the highest incidence of malpractice claims and highest malpractice costs, everything else equal.

Reform and practice size

While the effect of reform on the number of practicing physicians should be in the aggregate positive, the effect may vary across practice size and specialties. Large employers of physicians may be better able to manage the out-of-pocket costs of malpractice claims and earnings risk they induce. Kessler et al's (2005) finding of a larger positive supply effect for nongroup physicians compared to group physicians is consistent with groups being better able to manage the financial pressures of malpractice. Thus, we predict reforms will increase the relative attractiveness of nongroup practice to new physicians.

Reform and physician ability

Courty and Marschke (2008) take a contracting view of malpractice. Suppose that malpractice judgments do indeed have a random component to them, but in at least some specialties malpractice outcomes are strongly influenced by physician's efforts so that malpractice judgments (or their absence)

contain information about the quality of the physician's effort. The fact that some insurance companies impose premium surcharges to deter medical negligence (Rolph, p. 68) is consistent with this story, as is recent research finding that malpractice reform is associated with higher rates of preventable, adverse medical outcomes (Currie and MacLeod, 2008; Iizuka, 2013). Indeed, in some specialties a physician's malpractice record may be a measure of performance for which there is no good substitute. The discovery process in a malpractice suit often involves an in-depth and thorough investigation into a physician's past behavior as well as her behavior in the incident litigated, including assessments of her decisions and actions by experts. In such specialties, it is sensible to tie a physician's compensation more closely to the physician's malpractice record: carriers should adjust premiums to it, group practices should make a physician's contingent on it, and patients should use it to guide their choice of physician.

But malpractice reforms mute the malpractice record as a signal of physician ability, limiting its usefulness as a performance measure. Courty and Marschke argue that physician ability and the strength of available performance measures are complements, and thus reforms should be followed by a re-sorting of physicians by ability that benefits unreformed states. This sorting of physicians by ability is a boon for patients in unreformed states not just because the physicians that treat them are more able. More able physicians, Courty and Marschke argue, should face higher powered incentives, that is, their salaries and career success should be more closely tied to measures of performance, including their malpractice record. Thus, this sorting means not only more able physicians but also less moral hazard in unreformed states and the converse in reformed states. This argument thus predicts reforms will increase the attractiveness of the state to especially lower quality, new physicians.

3. Methods

Following Chou and Lo Sasso (2009), we estimate a conditional logit model in which the dependent variable is an indicator of location choice. The conditional logit model allows one to estimate the association between graduating physicians' location choices and state characteristics, including

malpractice reforms. Each graduating physician faces the same choice set – 50 states and the District of Columbia (we ignore the possibility of working abroad). The attributes of states within the choice set, however, vary across physicians since they are graduating in different years. The associations between state characteristics and location choice may vary by physician characteristics. In particular, as we motivated above, the effects of malpractice reform on location choice may vary by physician characteristics, such as specialty, practice size, and physician ability.

For physician i and state j, assume that U_{ij} is the utility the physician receives from choosing to locate in state j. It is the sum of a deterministic component η_{ij} and an error term ε_{ij}.

$$U_{ij} = \eta_{ij} + \varepsilon_{ij} \qquad (1.0)$$

This formulation is called the additive random utility model. The outcome $y_i = j$ if the outcome is the jth alternative, where j = 1, 2, …m. We observe that $y_i = j$ if locating in state j gives the physician the highest utility of all alternatives (Cameron & Trivedi, 2009).

$$\Pr(y_i = j) = \Pr\left(U_{ij} \geq U_{ik}\right) \; for \; all \; k \neq j$$

$$= \Pr\left(U_{ik} - U_{ij} \leq 0\right), all \; k \neq j$$

$$= \Pr[\left(\varepsilon_{ik} - \varepsilon_{ij}\right) \leq (\eta_{ij} - \eta_{ik})], all \; k \neq j \qquad (2.0)$$

In Equation 3 below, the underlying utility physician i receives from choosing state j depends on $\mathbf{x}_i$, which are individual characteristics that do not vary across alternatives (e.g., gender, race) as well as on $\mathbf{z}_{ij}$, which are attributes of the alternatives themselves, which may vary by individuals (e.g. whether a state has a damage cap in the year the physician graduates) (Rodriguez, 2016).

$$\eta_{ij} = \mathbf{x}_i'\beta_j + \mathbf{z}_{ij}'\gamma \qquad (3.0)$$

Note that since the probability of choosing to locate in a specific state depends on differences in errors, only m-1 errors, and only m-1 γ_j are free to vary, since probabilities must sum to 1 (Cameron & Trivedi, 2009).

This model is sometimes called a "mixed logit model" because it combines aspects of a multinomial logit model and a conditional logit model by including attributes of alternatives as well as individual characteristics (Cameron & Trivedi, 2005). It is estimated as a conditional logit model which includes interactions between each individual characteristic and a dummy indicator for each alternative, as well as dummy variables for each alternative (with a baseline alternative and an interaction between the baseline alternative and the individual characteristic left out). In our context, therefore, the model is estimated with a set of state fixed effects (New York State left out as the baseline) as well as with an interaction term for each individual characteristic interacted with each state (with New York interacted with that characteristic left out). To test whether the effects of state tort reform on location choice vary by physician characteristics, we also include in the model interaction terms between the characteristics of alternatives and physician characteristics.

4. Data

Data for this study come from the Survey of Residents Completing Training in New York (Exit Survey), an annual survey of all physicians completing a residency or fellowship training program in NYS. The survey, conducted by the New York Center for Health Workforce Studies, is designed to provide the medical education community in NYS with detailed information on the outcomes of residency training programs. The survey is fielded each spring through Graduate Medical Education administrators at all teaching hospitals in NYS. The survey includes questions about basic demographics, the name of the NYS residency/fellowship program, type and length of post-graduate training, the name of the medical school attended (if that school is located in NYS), specialty, educational debt, job market experience, and plans for practice after graduation (Armstrong, Chung & Forte, 2015).

In this study, we pool data from 12 years which include the 1998-2002, 2005, 2007, and 2008-2012 surveys. In future work, we will include data from the 2013-2015 surveys. The response rate over

the whole time period during which the survey has been conducted is about 61 percent (Armstrong, Chung & Forte, 2015). The analysis sample is limited to residents/fellows who were planning to enter patient care; had accepted a job offer at the time of the survey; and provided a valid zip code for the location where the new position was located.

Using the zip codes provided by the graduating physicians, we match state medical malpractice reform laws to physicians based on the year and the state in which the physician will be practicing.[2] In addition, we merge into the data information on state-level time-varying characteristics from the Area Resource File. The data on medical malpractice laws come from an extensive database on state tort law reforms that has been compiled and made publicly available by Ronen Avraham (Avraham, 2016). The database contains the following state malpractice reform laws: caps on non-economic damages; caps on punitive damages; caps on total damages; split recovery reform; collateral source reform; punitive evidence reform; periodic payments reform; contingency fee reform; patient compensation fund reform; and comparative fault reform. In this paper we focus on the non-economic and punitive damage caps, since these reforms have been shown to reduce medical liability costs (CBO, 2004), and because there are many states changing these two types of damage caps during our study period. As shown in Table 1, during our study period (1998-2012), 16 states either enacted or rescinded laws that place caps on non-economic damages, or made changes to the amount of the cap placed on non-economic damages. In addition, between 1998 and 2012, 9 states enacted punitive damage caps. The laws are coded as belonging to the subsequent year if they went into effect on or after July 1 of that year.

We interact the damage cap laws with measures of physician specialty, practice size, and physician ability. We use two indicator variables for physician specialty: (1) an indicator of "high risk" specialty if the physician specializes in any kind of surgery (including ophthalmology and

[2] Survey respondents were asked to provide the zip code or the city and state of their practice locations. In this version of the paper, we only had access to respondents' zip codes. Thus, we had to drop observations with city and state provided instead of zip code. In future work, we will be able to include respondents who provided city and state instead of the zip code, which will substantially increase our sample size.

otolaryngology), OB/GYN, emergency department medicine or radiology; and (2) an indicator of "low risk" specialty if the physician specializes in preventive medicine, pathology, allergy, rehabilitative medicine or dermatology. These categories are based on those of Klick & Stratmann (2007), who use data on average medical malpractice awards per doctor from the Florida Closed Claims Medical Malpractice data set. These authors categorize "high risk" specialists as those with the top 10 highest average awards, and "low risk" specialists with the lowest 10 average awards. We also consider a dichotomous indicator of osteopathic medicine as another measure of physician specialty; osteopathic doctors' training tends to emphasize primary care and de-emphasize surgical interventions.

To measure practice size, we use an indicator of whether the physician is entering either a solo practice or a partnership of two people. This survey question is consistent across all years except 1998, the first year of the survey. In this year, the survey response for partnership does not specifically specify a partnership of two people.

We have only limited proxies for physician ability. For physicians who went to medical school as well as residency in NYS, we know the name of the medical school the physician attended. For this sub-sample, we use median MCAT score at the medical school attended as a proxy for physician ability. There are 14 medical schools in NYS during our study period, including two osteopathic schools of medicine.[3] The range of median MCAT scores in our sample is 27-37. Nationally, an MCAT score of 30 represents about the 79th percentile, which is often the considered to be the cutoff for medical school acceptance.[4] Thus, we have a range of medical school quality in our sub-sample of physicians who attended medical school in NYS.

To measure physician ability, we also use an indicator of whether the physician is a US citizen who trained at a medical school outside the US and Canada. Most US citizens attending medical schools outside the US and Canada do so in the Caribbean. Caribbean medical schools have higher

[3] Albany Med, Albert Einstein, Columbia, Mt. Sinai, NYCOM, NYMC (Valhalla), NYU, SUNY Stonybrook, SUNY Buffalo, SUNY Brooklyn, Touro, U of Rochester, SUNY Syracuse, Cornell
[4] Source: http://medical-schools.startclass.com/d/a/New-York

acceptance rates and lower average MCAT scores than US medical schools. We also consider an indicator of whether the physician attended medical school outside the US and Canada which captures all international medical graduates, whether they are US citizens or not.

5. Empirical Findings

Table 2 shows sample means. The average age of the physicians in our sample is 33, and 41 percent of the sample is female. About 31 percent of our sample attended medical school in NYS, and 41 percent are international medical graduates. About 20 percent of the sample is starting a job in a state with a cap on noneconomic damages, and 26 percent is starting a job in a state with a cap on punitive damages. In the sample, the most common states chosen by physicians are: New York (60%); Florida (5%); California (5%); Pennsylvania (3%); and Texas (3%), and at least one physician chose 44 of the 51 alternative state options (results not shown).

Table 3 shows findings from conditional logit models which include indicators of a cap on noneconomic damages and a cap on punitive damages. The first two columns show results for the noneconomic damages cap models without state time-varying covariates (Table 3, Column 1) and with state time-varying covariates (Table 3, Column 2). The next two columns (Columns 3-4) show the same two models for punitive damage caps. Finally, Columns 5 and 6 show findings from models which include both indicators of damages caps at the same time, without state time-varying covariates (Table 3, Column 5) and with these state time-varying covariates included (Table 3, Column 6).

The findings in Table 3 indicate that a state's cap on noneconomic damages increases the likelihood that a new physician will choose to locate in that state. The estimated coefficient is positive and statistically significant at the 0.05 level, regardless of whether other state time-varying characteristics are included in the model, and regardless of whether indicators of caps on noneconomic damages and caps on punitive damages measures are included in the model at the same time (Table 3, Column 6). The state laws mandating caps on punitive damages, however, have no statistically

significant association with physician location. These estimated coefficients are positive in sign, but not statistically significant at conventional levels (Table 3, Columns 3-6).

If we compute the marginal effect of a state changing its noneconomic damages cap law on physician location, we will end up with 51 marginal effects for every state. In other words, the estimated positive coefficient on the noneconomic damages cap indicator suggests that passage of the law in one state increases the probability that physicians locate in that state, and decreases the probabilities that physicians choose to locate in each of the other 50 alternatives. It may be most policy relevant to consider marginal effects for NYS, and for other states commonly chosen by NYS residents. The model findings suggest that if New York were to implement a noneconomic damages cap law, the effect of that law would be a 0.04 increase in the probability that NYS residents choose to stay in NYS. This is about a 6 percent increase at the sample mean of 0.60. If Pennsylvania (PA) were to implement a noneconomic damages cap, the effect of that law would be a 0.005 increase in the likelihood that a NYS resident physician locates in PA, which is an 18 percent increase at the sample mean of 0.028. Similarly, the marginal effect of Texas (TX) enacting a noneconomic damages cap corresponds to about a 14 percent increase in NYS physicians choosing TX. For Florida, the marginal effect is 0.008 (a 17 percent increase at the sample mean) and for California, the marginal effect is 0.007 (a 17 percent increase at the sample mean). Thus, these findings imply magnitudes that are fairly large (results not shown).[5]

Table 4 shows findings from models which include indicators of caps on noneconomic damages along with interactions between these indicators and measures of physician specialty, practice size, and physician ability. Columns 1-3 in Table 4 show results from models that examine interactions with physician specialty. The findings suggest that the effects of noneconomic damages caps are stronger for high-risk specialty physicians, and weaker for low risk specialty physicians and for osteopathic physicians (Table 4, Columns 1-3). These findings are consistent with the idea that tort reforms should

[5] These calculations are based on the model shown in Table 3, Column 1.

have the strongest impact on physician behavior among those physicians who are most likely to face malpractice pressure. In future work, our sample size will be larger, and we will be able to examine effects for some specialties separately, such as surgeons and OB/GYNs.

Column 4 in Table 4 shows findings from a model which includes an interaction between noneconomic damage cap and solo/partnership practice. The findings from this model are intuitive. The damage cap has stronger effects for physicians entering solo practices or practices with one other partner. Physicians entering such practices are likely to be less insulated from malpractice pressure compared to physicians entering group practices and hospital-based positions.

Finally, in Columns 5-7 of Table 4, we consider interactions with proxies for physician ability. The findings suggest that the noneconomic damages caps have stronger effects on international medical school graduates in general, as well as on US citizens who attended international medical schools. We do not find, however, that among NYS medical school graduates, median MCAT scores interact with noneconomic damages caps. Although the sign of the estimated coefficient is negative, indicating that higher MCAT is associated with less response to the damage cap, the estimated coefficient is not statistically significant at conventional levels. Most (81%) physicians in our sample who attended both a NYS medical school and a NYS residency program choose to practice in NYS, and NYS does not have damages caps. Thus, this model is limited by only a small number of physicians entering states other than NYS. Overall, we have mixed effects that physician ability interacts with noneconomic damages caps in affecting location choice.

Table 5 shows findings from the same models, except the indicator of noneconomic damages cap in each model has been replaced by an indicator of punitive damages cap. Table 3 showed no evidence that a punitive damage cap affects physician location decisions. In Table 5, however, we observe that some interactions between physician characteristics and punitive damages caps are statistically significant. The pattern of findings is intuitive and consistent with previous findings for noneconomic damages caps. The punitive damages caps have stronger effects for physicians who face the highest

malpractice risk, and weaker effects for those who face the lowest malpractice risk (Table 5, Columns 1-2). Physicians entering solo/partnership practices respond more to punitive damages caps (Table 5, Column 4). Finally, as we saw before for noneconomic damages caps, caps on punitive damages have stronger effects for international medical school graduates, although we do not see statistically significant associations between median MCAT scores and punitive damage caps for physicians who attended medical school in NYS. In sum, Table 5 indicates that caps on punitive damages affect location choices among some sub-groups of physicians – physicians in high risk specialties, physicians entering solo or partnership practices, and international medical school graduates.

6. Conclusions and Future Work

With the passage of the Affordable Care Act in 2010, federal reform of malpractice laws is increasingly being viewed as part of a broader package of reforms to reduce waste and increase the cost-effectiveness of the health care system (Sage & Hyman, 2015). Findings from this paper will be helpful in informing this debate by providing recent information regarding how states' malpractice laws affect location decisions of new physicians. The results from this paper suggest that caps on damages, particularly noneconomic damages, are associated with an increase in physicians from NYS choosing to start their careers in those states that passed reforms. These effects are magnified for physicians in high medical malpractice risk specialties; physicians entering solo or two partner practices; and physicians from foreign medical schools.

One limitation of this paper is we cannot rule out the possibility that state tort reforms are endogenous. States may pass tort reforms, for example, to address a problem with physicians leaving the state due to malpractice pressure. Alternatively, passage of tort reform may be a proxy for physician political power in the state, or strong demand for physician services (Klick & Stratmann, 2007). We will attempt to address this issue in future work, in part by including a richer set of time-varying state

covariates. In future work, we also plan to explore lagged effects of tort reform; consider effects of the size of the cap on noneconomic damages; consider the possibility that states' enactment of policies may have different effects than states' rescinding of policies; and include a larger set of state tort reforms, including joint and several liability reform, collateral source reform, and periodic payments reform. We also plan to draw on 1987, 1991, and 1997 data from the Practice Patterns of Young Physicians' Survey, a longitudinal survey based on a random sample of physicians under the age of 40 in 1987 who had been in practice for 1–8 years since their residencies. The advantage of these data is we have better quality measures, including MCAT scores, undergraduate GPA and prior malpractice experiences.

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Table 1: Changes to states' caps on non-economic and punitive damages, 1998-2012		
State	Non-economic	Punitive
AL		2000-
AR		2003-
FL	2003-	
GA	2005-2009	
ID	1998-2008	2004-
IL	2006-2009	
MO		2006-
MS	2003-	2003-
MT		2004-
NV	2003-	
NC	2012-	
OH	2003-	2005-
OK	2004-	
SC	2006-	2012-
TN	2012-	2012-
TX	2004-	
OR	2000-	
AK	2006-	
WV	2003-	
WI	1998-2006	

Notes: In AK and WV, the amounts of the non-economic damages caps were changed in the years listed. In ID and WI, the amounts of the non-economic damages caps were changed every year in the time period listed. In OR, the cap on non-economic damages was repealed in the year listed. Source - Avraham, 2016.

Table 2: Sample Means	
Age	33.413 (4.72)
Female	0.409
US citizen	0.854
Asian	0.320
African-American	0.061
Latino	0.073
White	0.502
Osteopathic physician	0.087
Went to medical school in NYS	0.314
Survey year	2005.961
Median MCAT score of medical school attended, NYS physicians (n = 1,086)	32.908 (2.59)
ED	0.061
OB/GYN	0.062
Radiology	0.031
Surgery	0.078
Solo or partner practice (n = 5,007)	0.035
Works in HPSA	0.169
High risk specialty	0.231
Low risk specialty	0.221
Graduated from foreign medical school	0.407
US citizen graduated from foreign med school	0.267
Cap on noneconomic damages	0.195
Cap on punitive damages	0.260
Physicians per 1000 residents	3.377 (0.800)
Hospitals per 1000 residents	0.016 (0.008)
Hospital beds per 1000 residents	3.708 (0.714)

Notes: N = 5,287 unless indicated otherwise. Standard deviations shown in parentheses for continuous variables.

Table 3: Effects of damage caps on physician location						
	(1)	(2)	(3)	(4)	(5)	(6)
Cap on noneconomic damages	0.176**	0.186**			0.162**	0.175**
	(0.079)	(0.081)			(0.082)	(0.085)
Cap on punitive damages			0.183	0.171	0.101	0.085
			(0.151)	(0.156)	(0.157)	(0.530)
Hospital beds per 1000 population		0.105		0.144		0.103
		(0.139)		(0.296)		(0.139)
Hospitals per 1000 population		-30.41*		-31.99*		-31.77*
		(17.82)		(18.00)		(18.00)
Physicians per 1000 population		0.689**		0.603*		0.667**
		(0.301)		(0.304)		(0.304)
N observations	296,637					
N individuals	5,287					

Notes: Table shows estimated coefficients and standard errors from conditional logit model. Each column represents a different model. The choice set for each physician is the 50 states and the District of Columbia. Each model includes state fixed effects, with New York as the baseline category. * denotes statistically different from zero at the 0.10 level. ** denotes statistically different from zero at the 0.05 level. *** denotes statistically different from zero at the 0.01 level.

Table 4: Effects of caps on noneconomic damages on physician location: Interactions with physician characteristics							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cap on noneconomic damages	0.141* (0.083)	0.269*** (0.083)	0.204** (0.081)	0.090 (0.085)	-0.041 (0.088)	0.150* (0.084)	0.425*** (0.084)
Interactions with physician specialty							
Cap*High risk specialty	0.200** (0.082)						
Cap*Low risk specialty		-0.400*** (0.091)					
Cap*Osteopathic Physician			-0.230* (0.134)				
Interactions with practice size							
Cap*Solo/Partnership				0.339*** (0.110)			
Interactions with physician ability							
Cap*Int'l Med Grad					0.513*** (0.071)		
Cap*US Citizen Int'l Grad						0.134* (0.079)	
Cap*NYS Med School							0.123 (1.45)
Cap*NYS Med School*MCAT							-0.038 (0.044)
N observations	296,637	296,637	296,637	255,357	296,637	296,637	238,425
N individuals	5,287	5,287	5,287	5,007	5,287	5,287	4.675

Notes: Table shows estimated coefficients and standard errors from conditional logit model. Each column represents a different model. The choice set for each physician is the 50 states and the District of Columbia. Each model includes state fixed effects, with New York as the baseline category. Models also include hospital beds per 1000, hospitals per 1000 and physicians per 1000 in state and year. * denotes statistically different from zero at the 0.10 level. ** denotes statistically different from zero at the 0.05 level. *** denotes statistically different from zero at the 0.01 level.

Table 5: Effects of caps on punitive damages on physician location: Interactions with physician characteristics							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cap on noneconomic damages	0.135 (0.157)	0.254 (0.157)	0.183 (0.157)	0.108 (0.160)	-0.112 (0.159)	0.119 (0.158)	0.355** (0.162)
Interactions with physician specialty							
Cap*High risk specialty	0.148** (0.073)						
Cap*Low risk specialty		-0.410*** (0.081)					
Cap*Osteopathic Physician			-0.140 (0.115)				
Interactions with practice size							
Cap*Solo/Partnership				0.283*** (0.100)			
Interactions with physician ability							
Cap*Int'l Med Grad					0.638*** (0.063)		
Cap*US Citizen Int'l Med Grad						0.185*** (0.070)	
Cap*NYS Med School							-0.738 (1.27)
Cap*NYS Med School*MCAT							-0.019 (0.039)
N observations	296,637	296,637	296,637	255,357	296,637	296,637	238,425
N individuals	5,287	5,287	5,287	5,007	5,287	5,287	4.675

Notes: Table shows estimated coefficients and standard errors from conditional logit model. Each column represents a different model. The choice set for each physician is the 50 states and the District of Columbia. Each model includes state fixed effects, with New York as the baseline category. Models also include hospital beds per 1000, hospitals per 1000 and physicians per 1000 in state and year. * denotes statistically different from zero at the 0.10 level. ** denotes statistically different from zero at the 0.05 level. *** denotes statistically different from zero at the 0.01 level.

DATA APPENDIX

Zip Codes:

The sample is limited to physicians who have accepted positions in patient care in the United States. Each physician was asked to provide the zip code of the practice s/he is entering. If the zip code was unknown, the physician was asked to provide the city/town and state of the practice.

For physicians who provided valid zip codes, or zip codes that could be corrected for typos easily, we mapped the zip codes to the county and state FIPS.

For physicians who provided city and state, we found the zip code of the city, assigning the first zip code in cases of multiple zip codes for a city. The zip codes were then mapped to county and state.

For physicians who did not provide any location information, we could in some cases use responses to previous questions in the survey to determine that they are staying to practice in the same county of their current training hospital in NYS. We could map these respondents to zip codes by the name of their training hospital. Some respondents reported previously in the survey that they are staying in NYS. For these respondents, we know the state but not the county.

For respondents with missing state, we can be sure that they all left NYS. For respondents with missing county, we can be sure they all left the county in which they did residency.