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Medical Malpractice: How Legal Liability Affects Medical Decisions*

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Abstract

In health care, overuse and underuse of medical treatments represent equally dangerous deviations from an optimal use equilibrium and arouses concerns about possible implications for patients' health, and for the healthcare system in terms of both costs and access to medical care. Medical liability plays a dominant role among the elements that can affect these deviations. Therefore, a remarkable economic literature studies how medical decisions are influenced by different levels of liability. In particular, identifying the relation between liability and treatments selection, as well as disentangling the effect of liability from other incentives that might be in place, is a task for sound empirical research. Several studies have already tried to tackle this issue, but much more needs to be done. In the present chapter, we offer an overview of the state of the art in the study of the relation between liability and treatments selection. First, we reason on the theoretical mechanisms underpinning the relationship under investigation by presenting the main empirical predictions of the related literature. Second, we provide a comprehensive summary of the existing empirical evidence and its main weaknesses. Finally, we conclude by offering guidelines for further research.

Keywords: Medical Malpractice, Medial Liability, Treatment Selection, Defensive Medicine, Empirical Analysis, General Review

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Introduction

In health care, overuse and underuse of medical treatments represent equally dangerous deviations from an optimal use equilibrium. Among the factors that can affect these deviations, medical liability plays an important role as addressed by a remarkable economic literature which is the topic of this chapter.

An efficient medical liability system aims to incentivize adoption of an optimal level of precaution and compensates injured patients. This means that its goal is not the elimination of all medical errors from the system, rather the elimination of those for which the cost of prevention is less than the benefit of the avoided injury (*i.e.*, the expected damage).[1] There are two main liability rules targeting errors and the resolution of related claims. Under a negligence rule, providers are liable if they cannot prove that they complied with the standards adopted in their specialty. Under strict liability, providers are liable if they cannot prove that there is no causal link between their actions and an adverse event on the patient. Both rules and combinations of them are likely to affect the selection of medical treatments and sometimes the selection of patients on which treatments are performed.

Under a negligence rule, the perceived costs/benefits of taking precaution are influenced by (i) the certainty and strictness of the standard of care; (ii) the organization of the healthcare system (*e.g.*, physicians working in one or more hospitals); and (iii) the availability and type of malpractice insurance which limit a doctors' financial exposure. These three elements can come in many variations, leading to different degrees of liability for medical practitioners. As a consequence, they may induce less or more than efficient precautions. In particular, when physicians perceive a lower level of liability, they may be more prone to undertake riskier procedures favoring other types of incentives (*e.g.*, private incentives such as monetary gain, or patient-related such as better health outcomes). Differently, in the presence of high liability, non-optimal use of treatments leads to the so-called phenomenon of *defensive medicine*, which can be positive or negative (Danzon 2000; Kessler 2011). *Positive* defensive medicine coincides with the use of treatments or diagnostic tools that do not improve the quality of care delivered to patients, but which are apt to decrease the probability of a legal claim. This is a form of supplied induced demand and it implies an *overuse* of procedures compared to their optimal level. *Negative* defensive medicine is a sort of cream skimming of patients or procedures. Less risky patients are selected into treatment to decrease the probability of negative outcomes, and physicians avoid needed risky treatments due to fear

[1] For an in-depth explanation of the economics of medical liability, see Danzon(2000), Arlen (2013), and Grembi (2015).

of being sued. This is a situation in which a treatment can be *underused* overall, or the underuse takes place with respect to a specific segment of the population.[2] By the same token, strict liability systems may also induce a non-optimal use of medical procedures.[3] In particular, no fault systems are more likely to generate forms of negative defensive behavior. Since the effort and care undertaken in treating patients do not count in assessing the liability of practitioners, the easiest way to reduce the risk of litigation is to avoid riskier patients and/or the performance of riskier treatments.

Overuse and underuse of treatments arouses concerns about possible implications for patients' health, and for the healthcare system in terms of both costs and access to medical care. For these reasons, several countries have adopted reforms directly affecting the type of liability such as, for example, the UK which has introduced enterprise liability to mitigate the pressure faced by physicians. Other countries have opted for policies discouraging filing frivolous and unmeritorious claims or decreasing the overall financial exposure of health care practitioners. For instance, this is the case of those countries (*e.g.*, Italy, France) that have moved from private malpractice insurance for hospitals to public coverage by forcing regional governments to "insure" the liability exposure of hospitals through the creation of regional malpractice liability funds.

However, defining the optimal institutional response is a topic of debate, because there are factors other than liability pressure that can influence medical decisions. Identifying the relation between liability and treatments selection, as well as disentangling the effect of liability from other incentives in place, is a task for sound empirical research. Several studies have already tried to tackle this issue, but much more needs to be done. The existing evidence is based almost entirely on the US and disregards the experience of public healthcare systems, even though the problem of over- and under-use of treatments is equally important and widespread. The focus on the US experience also entails other two major limitations. Firstly, the response of physicians to variations in liability has been studied mainly within a negligence based system. Secondly, the US institutional setting implies some empirical

[2]Negative defensive medicine can also assume the form of non-adoption of new technologies, since standards are based on the *status quo*. For a discussion on how the liability system can deter the adoption of new technology, see Kessler (2011) and the UK Department of Health (2014).

[3]Examples of no fault system can be found in some US states with respect to some medical specialties (*e.g.*, Virginia and Florida), in Belgium and France for victims of medical injuries (Barbota, Parizotb and Winancea, 2014), and in the Scandinavian countries, though the latter adopt a milder form of no fault rules. In particular, the Scandinavian countries represent a benchmark which is discussed any time that policy makers deal with the problems associated with the medical liability system. In addition to having form of strict liability for practitioners and public insurance coverage, Scandinavian legal claims are not managed at the court level but by administrative authorities. For a description of these systems see Mello, Studdert, Kachalia and Brennan (2006) and Ulfbeck, Hartlev and Schultz (2012).

challenges that may undermine the findings produced so far.

The present chapter offers an overview of the state of the art in the study of the relation between liability and treatments selection. It discusses the main results of the existing empirical studies and their main shortcomings. First, we reason on the theoretical mechanisms underpinning the relationship under investigation by presenting the main empirical predictions of the related literature. Second, we provide a comprehensive summary of the empirical evidence. Finally, we discuss the main weakness of the estimations run so far and conclude by offering guidelines for further research.

Theoretical Expectations

The assumption of any theoretical prediction on how changes in liability affect medical decisions is that healthcare practitioners are concerned about facing a legal claim. Even when providers can get insurance for medical liability which reduces their financial risk,[4] they still see malpractice claims as a serious threat because they carry non-insurable costs, including serious reputational damages (Sage, 2004), and significant psychic and time costs.[5]

The probability of facing a claim is directly correlated to that of committing an error which cannot be voided. As suggested by Arlen and MacLeod (2005), although doctors may raise their level of precaution and invest in their expertise to minimize their chances of making an error, they cannot eliminate the risk. Consequently, conventional wisdom interprets overuse and underuse of medical treatments as defensive behaviors on the part of healthcare providers to decrease their risk of being sued. It relates more intensive treatments or overuse of treatments to lower probability of claims, so that the higher (lower) the liability pressure the more (less) likely are intensive treatments. Consider, for instance, the case of a delivery when a physician has the choice between a cesarean section (more intensity) and a vaginal delivery (less intensive). With c-sections doctors reduce the risk to the babies (*i.e.*, the most expensive potential injured) and they can better control what actually happens in the delivery room. Hence, conventional wisdom sees a c-section as a defensive mean for

[4]Claims are unlikely to lead to payouts that exceed the limits of professional liability insurance (Fisk, 1998; Hyman, Black, Zeiler, Silver and Sage, 2007). Moreover, malpractice premiums for hospitals are partially experience-rated, while those of individual physicians are not (Mello, 2006). Hence, at least on the individual level, premiums are not expected to increase due to a physicians' involvement in malpractice suits. Even if this were not the case, providers can, to some extent, shift insurance premiums to patients by raising medical fees (Danzon, 1991; Sloan, 1982).

[5]Seabury,Chandra, Lakdwalla and Jena (2013) show that doctors, on average, spend over 4 years of a 40-year career with an open malpractice claim. However, there is no clear evidence on the magnitude of reputational costs.

doctors against the risk of litigation. It follows that whenever there is a decrease in liability pressure, c-sections should be less appealing to doctors and be less frequently performed. However, the empirical evidence is mixed in this respect and challenges this interpretation.

To explain the conflicting evidence, more recent contributions try to take a broader picture into account. Two models best identify this attempt: the model proposed by Currie and MacLeod (2008) and the one in Shurtz (2014). Currie and MacLeod (2008) is the first model on the choice between a less and a more intensive treatment, and considers the probability of a doctor facing a claim related to a medical error both when performing the treatment and when denying it. Doctors may damage a patient by mistakenly choosing a wrong medical treatment, but also by withholding a treatment that would have been beneficial. The starting point of the model is that physicians weigh the costs and benefits of their choices given the liability rule they face.[6] The latter include, among the others, the benefits of treating patients and monetary incentives. The former consist of the expected liability that physicians will incur by committing an error. When a physician is indifferent between denying or providing the treatment to a patient, that patient is defined as marginal. What a variation in liability does is to change a doctor's decisions with respect to the marginal patient. As a consequence, Currie and MacLeod (2008) do not explain *how* doctors perform a given treatment, but rather *whether* they perform it or not. They focus on a quantitative dimension, which is the number of treated patients, and offer guidance to evaluate the effects of a variation in liability on the levels and composition of medical activities. Generalizing the findings of the model, the direction of the impact produced by a change in medical liability on the use of a treatment is an empirical issue. It depends on the risk-risk trade-off between providing or withholding the treatment to the marginal patient. The final effect on the utilization rate of a procedure cannot be uniquely determined *ex ante* on theoretical grounds. For instance, if we move from a point in which there is an overuse of a treatment, which means it is not related to medical factors, then the probability of an error or a negative outcome is higher with the use of that procedure than without it. This means that whenever an increase in malpractice pressure strikes (*i.e.*, physicians are held more accountable), the incidence of that procedure should decrease rather than increase. Differently, in cases of initial overuse, providers have no incentive to reduce the use of inappropriate procedures after a reduction in liability, rather, they may be induced to increase them.

Shurtz (2014) addresses the inconsistencies in the empirical literature, providing room

[6]The model abstracts the resource constraint, which in reality can affect the treatment choice set. Within this theoretical framework, the decision to provide a treatment or not is driven, on the costs side, exclusively by liability considerations.

for the financial incentives borne by practitioners. Basically, according to Shurtz (2014), the theoretical literature lacks a proper vision of the mechanisms underneath the effects or the lack of effects due to changes in medical liability. He moves from the initial distinction made by Currie and MacLeod (2008): physicians might underuse or overuse a treatment, but he relates these choices to financial incentives. The benefits of a treatment come from the benefits on the patient conditions and physicians' monetary benefits. The costs include medical liability and the opportunity costs of withholding the procedure. In this context, underuse might be explained by the treatment being too costly, and overuse by the treatment being extremely beneficial money-wise, even discounting for the risk of errors (*i.e.*, the risk of being sued). This means that if there is an increase in liability, the costs side of the decision to perform or not perform a treatment increases, and the change in liability offsets financial considerations at the margin. As a consequence, when c-sections are underused because they are unprofitable, an increase of liability makes it even more convenient not to perform a c-section. When c-sections are profitable, physicians overuse them on the basis of financial considerations, but an increase in liability contrasts this tendency making c-sections less appealing. By the same token, lower liability provides further incentives besides monetary ones to further withhold c-sections, when they are already underused. Conversely, if the same reduction in liability strikes when c-sections are profitable, this enhances the physicians' incentive to overuse cesarean deliveries and c-sections further increase.

Empirical Analysis

The common core of the empirical literature on how malpractice liability affects medical treatments is to test the existence and assess the magnitude of defensive medicine, and in particular, positive defensive medicine. This task poses two major empirical challenges. First, labelling a treatment as underused or overused assumes that it is possible to identify its optimal use. This is easier in theory than in practice. In practice, optimal use is inferred *ex post* by checking whether the effect detected at the treatment level is associated with any effect on the health status of patients. For instance, besides estimating the effect of a variation in liability on c-section rates, it is necessary to also estimate the effect on maternal and neonatal health outcomes. If a decrease in c-sections is combined with no change or improvement of the health status of mothers and newborns, then the initial level of cesarean sections is defined as overuse. If their health status deteriorates, the initial incidence of c-sections was ideal.

Second, underuse and overuse of treatments can be triggered by several factors, in addition to liability. Physicians have different skill levels (Currie, MacLeod and Parys, 2017) and/or are subject to monetary incentives (*e.g.*, Gruber, Kim and Mayzlin, 1999). Hence, it is important to choose an institutional setting that allows one, to clearly disentangle these channels from medical liability. In this perspective, the choice of a medical treatment or medical specialty to be investigated is important. The existing empirical literature focuses mainly on obstetrics and cardiology. Beside accounting for a significant share of all medical spending, these specialties require patients' hospitalization. Hence, problems of sample bias due to self selection between inpatients and outpatients are minimized. Moreover, the liability pressure is significant for both cardiology and obstetrics, accounting for the highest levels of malpractice premiums and claim rates. Thus, a variation in liability should be particularly salient to their practitioners (Mello and Kachalia, 2010; Avraham and Schanzenbach, 2015). Another advantage is the possibility of studying substitution between high-intensity and low-intensity treatments (c-section vs. natural birth, and drug therapy vs. angioplasty and bypass) in which a physicians' discretion plays a crucial role.

Overall, the empirical contributions on the effects of medical liability on treatment selection can be grouped in three sets. The first set includes all contributions addressing the causal relation between treatment selection and changes in liability due to torts reforms (*e.g.*, adoption of caps or changes in the type of liability). The second set compares the behavior of providers facing different degrees of liability (*i.e.*, high vs. low liability pressure) as measured by the level of malpractice insurance premiums, the frequency of claims and/or their severity. The third set groups all contributions that use health outcomes (*e.g.*, prenatal care, mortality rates, complications) as proxied by the healthcare system quality, and infer the effect on treatment decisions by studying the relationship between changes in liability and health outcomes. Broad and detailed surveys of these vast sets of papers are provided by OTA (1993), CBBO (2004), Studdert, Mello and Brennan (2004), Mello (2006), Kane and Emmons (2007), Nelson, Morrisey, and Kilgore (2007), Mello and Kachalia (2010), Kachalia and Mello (2011), RAND (2011), and Kessler (2011).

We leave the contributions of the third set out of this review, because they are not focusing on treatment selection, but they assume that there is one. Hereafter, we focus on attempts to identify the effect of a change in liability on treatments selection exploiting some sort of quasi natural experiment, and their main shortcomings. We compare these studies with those on variations of liability pressure, and draw some policy implications.

Existing Evidence and Its Limitations

The empirical literature that uses tort reforms as an exogenous variation in liability is entirely focused on the case study of the US. The period covered by this literature includes liability reforms from the eighties to the first decade of the new millennium. Most of these reforms have been common to many US states. As is apparent from Table 1, these reforms are aimed at making a malpractice claim less profitable for injured parties and their attorneys (*e.g.*, caps on damages and caps on contingency fees), or at aggravating the procedural burden of the plaintiff (*e.g.* certificate of merit, pretrial screening, and status of limitations). Overall, the reforms should discourage frivolous or unmeritorious claims, facilitate settlements, and consequently facilitate more accurate predictions of an insurer's risk. Hence, tort reforms are usually associated with lower liability pressure. An exception is the abolition of the joint and several liability (JSL) rule, which represents an increase in liability (Kornhauser, 2013). If a claim involves more defendants, such as the hospital and the employed physician, the physician can rely on group resources to face the claim. JSL reforms eliminate this possibility, forcing physicians to bear all costs of a trial on the basis of their share of liability.

Table 2 summarizes the major contributions published over the last twenty years, mainly in economic journals. These works produce mixed evidence, despite the fact that they consider the same country, they exploit the same reforms, they sometimes use the same data, and they rely on similar empirical strategies. The most common approach exploits the implementation of tort reforms—especially caps on damages— at the state level to group the states in treated and controls, and to identify the final effect with a difference in differences estimation.

Among the contributions on obstetrics, tort reforms decreasing liability pressure have been found to have no impact on cesarean sections (Frakes, 2012; Sloan, Entman, Reilly, Glass and Hickson, 1997), to decrease cesarean sections (Esposto, 2012), and to increase cesarean sections (Currie and MacLeod, 2008). Currie and MacLeod (2008) find that caps on pain and suffering increase the performance of cesarean delivery and complications of labor, whereas joint and several liability reforms reduce them. This is consistent with the model that they present, since they argue that the starting point of the system coincides with an overuse of cesarean sections. Differently, Frakes (2012) suggests that the use of c-sections is insensitive to tort reforms, including both caps on pain and suffering, and joint and several liability reforms. Shurtz (2014) offers a further stance. Consistent with his model, the author shows that caps on pain and suffering (P&S) increase c-section use when the procedure is more profitable and decrease it for less remunerative mothers. The picture does not improve

Table 1: **Major Torts Reforms Analyzed in the Literature**

Tort Reform	**Basic Description**	**Effect on Liability Pressure**
Panel A: Reforms affecting the payouts		
Abolition of mandatory prejudgment interest	No mandatory interest on either awards for pain and suffering or final compensation due in relation to the filing of the claim or occurrence of the injury	⇓
Caps on Economic Damages	Limits on the economic component of the compensation for a malpractice case	⇓
Caps on Pain and Suffering	Limits on the noneconomic component (emotional pain and suffering") of the award that can be granted in malpractice cases	⇓
Caps on Punitive Damages	Limits on the award aimed to punish the misconduct of the defendant	⇓
Caps on Total Damages	Limits on the final award that can be granted in malpractice cases	⇓
Collateral-source Rule Reform	Under collateral-source rule, the defendant cannot bring into evidence amounts paid as compensation to the plaintiff from other sources (e.g., health insurance). Reforms to this rule make admissible such evidence and allow deduction the amounts from other sources from the amount due by the defendant	⇓
Patient compensation Funds (CPFs)	Patient compensation funds supplement private malpractice coverage. A CPF pays the part of the award exceeding the malpractice coverage of the defendant	⇓

At times, these reforms have been adopted with reference to the entire liability system. At other times, they have affected only the medical liability.

Table 1: **Major Torts Reforms Analyzed by the Literature (Cont'd)**

Tort Reform	**Basic Description**	**Effect on Liability Pressure**
Panel B: Reforms affecting liability		
Join and Several Liability (JSL) Reform	In cases with multiple defendants, reforms to the JSL rule limit what a plaintiff may collect from each defendant to their share of liability	⇑
Panel C: Reforms affecting claims' procedure		
Caps on Contingency Fees	Limits on the amount of money that a plaintiff's attorney may receive as contingency fee. Caps can be stated as a maximum monetary value or as a percentage of the damage award	⇓
Certificate of Merit (COM)	When filing a claim or soon thereafter, the plaintiff must provide an affidavit attesting that a medical expert confirms the merit of the claim	⇓
Mandatory Periodic Payments	Part or all of the award must be paid to the plaintiff over an extended period of time as an annuity, rather than in a lump sum. In case of the plaintiff's death, insurers can terminate the payment	⇓
Pretrial Screening Panels	Expert panels are called to express an opinion on the merit of a claim and, in some cases, on damages. Panels' negative opinions are not binding, but are admissible into evidence during a trial	⇓
Shortening of Statutes of Limitations	Shortening the length of time a patient has to file a claim once she has been injured or she has discovered the injury	⇓

At times, these reforms have been adopted with reference to the entire liability system. At other times, they have affected only the medical liability.

by moving from a difference in differences approach to the use of instrumental variables. Dubay, Kaestner and Waidmann (1999) use state liability law reforms as an instrument, concluding that high liability pressure is associated with more c-sections only for some groups of women (*e.g.*, unmarried women). Esposto (2012) relies on a similar instrument, but concludes in favor of a generalized increase in c-sections.[7]

Results are also mixed in the case of cardiology. Kessler and McClellan (1996) find that a broadly defined class of tort reforms (including caps on pain and suffering) is associated with a reduction of 5-9% in medical expenditures for elderly heart patients with no consequence on their health. They take this reduction as evidence that physicians practice defensive medicine. Kessler and McClellan (2002a) build on their 1996 work and control for managed care enrollment rates to include the effect of a more cost-conscious environment. The results are consistent with their previous work, but the magnitude is halved. Later, in a study for the Congressional Budget Office, Beider and Hagen (2004) try unsuccessfully to replicate the results of Kessler and McClellan. Sloan and Shadle (2009) revisit the same results and fail to find any effect on both expenditures and health outcomes. More recently, Avraham and Schanzenbach (2015) report that caps on pain and suffering reduce treatment intensity without affecting mortality rates from coronary heart diseases. Overall, the use of angioplasty and bypass is lower, but there is a substitution effect, with angioplasty becoming more frequent than bypass. Their evidence is strictly related to the predictions of the model in Shurtz (2014).

Broadening the class of patients further clouds the picture. For example, according to Sloan and Shadle (2009), there is no relation, at all between tort reforms and hospitalizations. Cotet (2012) suggests a negative relation at least between caps on pain and suffering and surgeries, hospital admissions and outpatients visits, but no effect on emergency care. Xu, Spurr and Fendrik (2014) points out the importance of the cap's level. The authors report that caps on pain and suffering of $250,000 are associated with a reduction in referrals to specialists, whereas they do not observe any effect for higher levels of caps.

Despite their mixed findings, these studies deserve consideration because they attempt to assess the theoretical expectations. Yet, they suffer from a series of drawbacks in part due to some characteristics of the US institutional setting. In the US, different tort reforms are often enacted together, so that disentangling a malpractice law from others is challenging. Moreover, a tort reform is usually coded through a binary variable taking the value of 1 when

[7]Specifically, Esposto (2012) use as an instrumental variable a dummy for the implementation of a tort reform in the previous 3 years regressed on economic, political, and legal factors to account for the political environment in a state.

Table 2: **Previous Empirical Research on Defensive Medicine**

Study& Journal	**Period& Country**	**Policy**	**Results**	**Approach**	**Specialty**
Kessler and McClellan (1996) QJE	1984, 1987 and 1990 US	A dummy to control for the implementation of a direct tort reform (i.e., cap on damages, abolition of punitive damages, no mandatory prejudgment interest, collateral-source rule reform) and a dummy for an indirect tort reform (i.e., cap on contingency fees, mandatory periodic payment, JSL reform, patient compensation fund)	Direct tort reforms lead to a reduction in hospital expenditures for both heart attack patients and heart disease patients, with no significant variation in mortality rates or cardiac complications. Indirect reforms produce no effects	DD	Cardiology
Dubay et al. (1999) JHE	1990-1992 US	Malpractice pressure expressed through contemporaneous malpractice premiums for obstetricians. Malpractice premiums for neurosurgeons and state tort reforms used as instruments. As tort reforms, the authors consider: caps on total damages, caps on damages for P&S, time limits on discovery, discretionary pretrial screening, and mandatory pretrial screening	A high liability risk induces physicians to perform more c-sections especially for mothers with lower socioeconomic status. On the contrary, there is no effect with respect to neonatal health outcomes	FE models and IV	Obstetrics
Kessler and McClellan (2002) JPube	1984-1994 US	A dummy to control for the implementation of a direct tort reform (i.e., cap on damages, cap on P&S, abolition of punitive damages, no mandatory prejudger interest, collateral-source rule reform) and a dummy for an indirect tort reform (i.e., cap on contingency fees, mandatory periodic payment, JSL reform)	Direct tort reforms reduce defensive practices in areas with high and low managed care enrolment, but such a reduction is higher in areas with low managed care enrollment as managed care and liability reforms are substitutes. Indirect reforms produce no effects	DD	Cardiology
Kessler and McClellan (2002) JHE	1984-1994 US	A dummy to control for the implementation of a direct tort reform (i.e., cap on damages, cap on P&S, abolition of punitive damages, no mandatory prejudgment interest, collateral-source rule reform) and a dummy for an indirect tort reform (i.e., cap on contingency fees, mandatory periodic payment, JSL reform)	Direct tort reforms lead to a reduction in claim frequency and subsequently, treatment intensity, but without any substantial change in health outcomes. Indirect reforms produce no effects	IV	Cardiology

Notes: *Caps on P&S*= Caps on pain and suffering; *JSL*= Joint and Several Liability Reforms; *JHE*= Journal of Health Economics; *JLE*= Journal of Law and Economics; *JPube*= Journal of Public Economics; *QJE*= The Quarterly Journal of Economics. *DD*=Difference in Differences. *IV*= Instrumental Variable.

Table 2: **Previous Empirical Research on Defensive Medicine (Cont'd)**

Study& Journal	**Period& Country**	**Policy**	**Results**	**Approach**	**Specialty**
Esposto (2008) EEJ	1987, 1990 and 1993 US	A dummy to control for the implementation of a direct or indirect tort reform (*i.e.*, cap on damages, abolition of punitive damages, no mandatory prejudgment interest, collateral-source rule reform, cap on contingency fees, mandatory periodic payment, JSL reform, patient compensation fund) for at least two years for the OLS, and three years for the IV	5% drop in the use of diagnostic tools	OLS and IV	Diagnostic treatments
Currie and MacLeod (2008) QJE	1989-2001 US	Caps on P&S and JSL	More cesarean sections and more complications of labor with caps, fewer cesarean sections and fewer complications with JSL	DD	Obstetrics
Yang et al. (2009) Medical Care	1991-2003 US	Average liability insurance premiums paid by obstetrician-gynecologists in each state as a proxy of liability pressure. Four dummies for caps (1 punitive damages cap and 3 levels of cap on P&S) and individual dummies for each of the following reforms: attorney fee limits, modification of the collateral source rule, expert-witness restrictions, modifications to JSL rules, periodic payment of awards, shortening of statutes of limitations, and pretrial screening panels	Caps on P&S and pretrial screening panels reduce c-section and increase the numbers of vaginal deliveries after a c-section. Statistically significant association between malpractice pressure and delivery method in obstetrical practices	State-level longitudinal mixed-effects model	Obstetrics
Sloan and Shadle (2009) JHE	1985-2000	A dummy to control for the use of a direct tort reform (i.e., caps on damages, abolition of punitive damages, eliminating mandatory prejudgment interest, and collateral source offset) and one for indirect tort reforms (i.e., limitations on contingency fees, mandatory periodic payments, JSL reform, and patient compensation fund)	Both direct and indirect reforms have no effect on payments for Medicare-covered services (i.e. physicians' decisions) nor on health outcomes	OLS and Probit	Cardiology, Oncology, Diabetology, and all hospitalizations

Notes: *Caps on P&S*= Caps on pain and suffering; *JSL*= Joint and Several Liability Reforms; *ALER*= American Law and Economic Review; *EEJ*=Eastern Economic Journal; *JHE*= Journal of Health Economics; *QJEC*= The Quarterly Journal of Economics. *DD*=Difference in Differences. *IV*= Instrumental Variable.

Table 2: **Previous Empirical Research on Defensive Medicine (Cont'd)**

Study& Journal	**Period& Country**	**Policy**	**Results**	**Approach**	**Specialty**
Cotet (2012) ALER	1990-2006 US	Caps on P&S	Reduction of surgeries by 3.5%, admissions by 2.5% and outpatient visits by 4.5%, while they have no significant effect on emergency care	OLS	Broad definition of health care delivery
Esposto (2012) AEL	1987, 1990 and 1993 US	A dummy to control for the implementation of any of the following reforms: caps on damages, abolition of punitive damages, no mandatory prejudgment interest and collateral-source rules, caps on contingency fees, mandatory periodic payments, JSL reform, patient compensation funds	The implementation of a tort reform leads to a lower rate of cesarean delivery (4%)	OLS and IV	Obstetrics
Frakes (2012) JELS	1979-2005 US	Caps on P&S, caps on punitive damages awards, reforms of the collateral source rule, and other indirect tort reforms (i.e., contingency fee limitations, requirements of periodic payment of future damages, JSL reforms, patient compensation fund)	No significant effect on c-sections (the adoption of a cap on P&S would only be associated with a -1.2 percentage point reduction in prevailing cesarean rates, representing a relatively modest 5% reduction in the prevailing cesarean rate) and neonatal health outcomes, while episiotomies decrease and maternal lengths of stay are shortened	DD	Obstetrics
Xu et al. (2013) HEPL	2003-2007 US	Caps on P&S, frequency and severity of medical malpractice claims (i.e., median payment of paid claims and number of paid claims per 1,000 physicians), and medical malpractice premiums	A statutory cap on P&S of $250,000 has a significant and negative effect on referrals. No effects of paid claims, premiums or higher caps	Binary Logistic	Referral visits to specialists

Notes: *Caps on P&S*= Caps on pain and suffering; JSL= Joint and Several Liability Reforms;$ALER$= American Law and Economic Review; JHE= Journal of Health Economics; AEL= Applied Economic Letters; $HEPL$= Health Economics, Policy and Law; $JELS$= Journal of Empirical Legal Studies; JLE= Journal of Law and Economics;*N Engl J Med*= The New England Journal of Medicine; QJE= The Quarterly Journal of Economics. DD=Difference in Differences. DDD=Difference in Difference in Differences. IV= Instrumental Variable.

Table 2: **Previous Empirical Research on Defensive Medicine (Cont'd)**

Study& Journal	**Period& Country**	**Policy**	**Results**	**Approach**	**Specialty**
Shurtz (2014) JLE	2000-2007 US	Caps on P&S combined with financial incentives	Caps implementation produces an increase of c-section when these procedures are profitable (i.e., when mothers are commercially insured)	DD and DDD	Obstetrics
Waxman et al. (2014) N Engl J Med	1997-2001 US	Changes in the malpractice standard for emergency physicians	No reduction in the rates of CT or MRI utilization or hospital admission and charges in Texas and Carolina. In Georgia, the reform was associated with a 3.6% reduction in per-visit emergency department charges	DD	Emergency care
Avraham and Schanzenbach (2015) JHE	1998-2009	Caps on P&S	The introduction of caps on P&S leads to a lower probability of receiving either an angioplasty or a bypass by 1.24-2 percentage points. Despite the overall negative net effects, caps on P&S reduce the use of angioplasty by 2 percentage points, but increase that of bypass 0.5-0.6 percentage points. No effects on the mortality rates from coronary heart disease is observed	DD and DDD	Cardiology

Notes: *Caps on P&S*= Caps on pain and suffering; *JSL*= Joint and Several Liability Reforms;*JHE*= Journal of Health Economics; *AEL*= Applied Economic Letters. *DD*=Difference in Differences.

the reform is active and zero otherwise. However, malpractice laws of the same type come in many variations. Collapsing them into a dummy variable does not allow one to capture these variations (*e.g.*, different levels of caps, different nuances of JSL), and fails to take into account the different intensity of the reforms.[8] Finally, this type of coding disregards the fact that reforms do not necessarily affect medical liability in the same direction.

Given the wide range of malpractice laws and their scattered implementation, there has been discretionality in deciding what reforms to include in the analysis. The existing studies make different choices in this respect even when they consider similar time periods and the same states. For instance, Kessler and McClellan (2002a and 2002b) disregard the implementation of patient compensation funds included in their 1996 paper. Both Currie and MacLeod (2008) and Yang, Mello, Subramanian and Studdert (2009) rely on Natality Detail Files on births in the whole US for similar periods, but the former focus on caps on pain and suffering and joint and several liability reforms, whereas the latter control for nine different reforms.

To understand the complexity and magnitude of the problem, consider caps on P&S and JSL reforms. These two types of reforms are among the most exploited in empirical studies and, from a theoretical point, they are expected to produce different effects, as shown in Table 1. Caps should decrease liability pressure, while joint and several liability should increase it. Figure 1 depicts the adoption of these two reforms in the US states. Data comes from the Database of State Tort Law Reforms, DSTLR 5^{th} (Avraham, 2015) which is the primary source on medical liability state laws and covers 1975-2012. The light grey color indicates the application of caps on P&S, dashes the presence of JSL reforms, dark grey the joint implementation of caps on P&S and JSL reforms, and white areas coincide with states which have neither. A simple graphical inspection shows how often these reforms are concurrent, as well as the great variability in their application, with several states adopting and repealing them. For instance, Wisconsin was enforcing caps on P&S in 1990. Two years later, caps were no longer in place, but they were re-instated jointly with JSL in 1995. Given the expected effects on liability of these reforms, healthcare providers in Wisconsin faced less pressure in 1990, and more pressure in 1992, while the net result of the opposite effects of the two reforms in 1995 is questionable. Hence, it is difficult to isolate the effect of a single reform, or to estimate the joint impact of different reforms.

[8]For instance, if five reforms decreasing the pressure of liability are implemented in State X and one in State Y, the intensity of the overall malpractice system in X is likely much lower than Y. However, it might be difficult to express this with a binary variable. In addition, using a dummy for malpractice laws fails to control for the effects of those reforms that are upheld or never challenged by courts, and further confounds the final effect.

Take in Figure 1 and Figure 2

There is a further complication in how reforms are coded in the US case. Figure 2 has been plotted always using DSTLR 5^{th} (Avraham, 2015), but in the so-called *clever* version. In this case, some reforms are considered not to be in place based on their supposed inability to affect the liability pressure of physicians. For instance, caps above $400,000 are considered too high to be binding, thus their implementation is ignored. Similarly, reforms in place for 3 years or less are disregarded. In the case of Wisconsin, this means that the adoption of caps on P&S in 1990 effectively never happened. Comparing only the adoption of caps on P&S in a single year, the DSTLR 5^{th} reports 19 states applying caps in 1997, which goes down to 12 according to the clever version of the DSTLR 5^{th}. Both of these versions of the dataset on medical malpractice laws have been used in the empirical literature. This may be one additional cause of the mixed evidence, and further stresses the importance of the institutional setting for the findings.

Finally, the expectations on caps merit further discussion as they are the most studied of the possible tort reforms. Regardless of the type of awards they apply to, caps are believed to have a substantial impact on medical liability. They are supposed to reduce uncertainty on expected malpractice payouts, as they set a maximum amount that victims can receive. Yet, caps are upper bounds to damages awards, and their effect on the certainty of compensations is not clear.[9] As they eliminate the right tail of the distribution of compensations, they can reduce its mean (Avraham, 2007), but it is hard to predict how they impact the variance. In addition to reducing uncertainty, caps are expected to lower malpractice premiums and reduce the number of malpractice claims. Higher certainty of payouts and lower average awards should facilitate more accurate predictions of insurers' risk exposure and reduce incentives for injured patients to file a claim. However, the empirical evidence on the effect of caps on insurance premiums is mixed and inconclusive, as addressed by Kessler (2006), and Zeiler and Hardcastle (2013).

Liability Pressure

The second main strand of literature on the relation between liability and medical decisions focuses on the effect of different degrees of liability. Instead of using policy changes as an

[9]Scheduled damages are an alternative to adoption of caps. Scheduled damages are tiered caps which establish the precise amount of compensation for every disability percentage, conditional on the victim's age. They are adopted mainly outside the US–in the US only for work injuries. For an application, see Bertoli and Grembi (2017).

exogenous variation in liability, these papers try to measure liability mainly by looking at the level of premiums, and the severity and/or frequency of claims. This approach can better take into account the institutional complexity of the cases under examination. Nevertheless, the findings of many of these works are again mixed. One explanation is that these contributions often fail to control for unobserved factors that may affect both the selection of treatment and the degree of liability. For instance, in the case of c-sections, this would be the case if there is proof of a correlation between high premiums and high c-section rates without controlling for the characteristics of the providers and the population. High premiums may reflect the poor quality of the providers or the poor health status of the population, and both phenomena may lead to a high incidence of c-sections. In addition, malpractice risk is often measured through physician-based rather than population-based indexes. Finally, premiums may not necessarily be a good proxy of liability, because physicians may be unresponsive to their variations. In fact, since malpractice premiums are not risk adjusted on the basis of individual claims history, physicians may not associate high premiums with a higher probability of being sued.

Among these works, those reported in Table 3 are which suffer the least from drawbacks. In particular, Frakes (2012) and Shurtz (2013) are worth mentioning for the US case. Frakes (2012) proposes a different policy measure to address the inconsistency of the evidence produced by the literature, especially the inconsistency about the effects of caps adoption on use of treatments. The starting point of the study is that under a negligence rule, providers are held liable when they do not comply with the standard of care adopted in their specialty. Hence, he collected information on the standards of care for all US states, paying particular attention to whether and when the states switched from a local to a national standard during 1977-2005. Restricting the field to obstetrics and cardiology, Frakes (2012) finds an enormous impact of the switch to the national standard on the gap between local and national rates of procedures. This is an important finding that sheds further light on the mechanisms in place during treatments selection: physicians are responsive to standards of care. Shurtz (2013) uses microdata at the physician level to show how physicians behavior changes after being the target of a liability claim. After a suit, cesarean sections jump to 4%. This evidence confirms that physicians do care about the risk of being found liable, and is produced by implementing an event study that allows him to control the specifics of doctors.

In this strand of literature, evidence from other countries and based on public healthcare systems is also found: in particular Fenn, Gray and Rickman. (2007) and Amaral Garcia, Bertoli and Grembi (2015). Both papers take advantage of policies that are well targeted

and identify a variation in liability that occurs in the absence of any other change in the medical liability system. Fenn *et al.* (2007) use data from the UK to show how a higher level of risk exposure due to a pooling insurance scheme increases the use of diagnostic tools, while Amaral Garcia *et al.* (2015) provide evidence supporting the model of Currie and MacLeod (2008). Using Italian data, Amaral Garcia *et al.* (2015) investigate the effect of the implementation of an experience rated insurance policy at the hospital level that makes physicians more accountable. The increased liability pressure proves to lead to a decrease in the use of cesarean sections.

Table 3: **Liability pressure and defensive medicine**

Study& Journal	**Period& Country**	**Policy**	**Results**	**Approach**	**Specialty**
Sloan et al. (1997) IRLE	1987 US	Malpractice risk expressed as physicians' claims history (suit rates). Four measures: (1) number of claims per exposure year incurred by the individual obstetrician; (2) a set of binary variables classifying the individual obstetrician according to his/her claims experience; (3) number of claims per exposure year incurred by all obstetricians in the physician's county; and (4) total payments, indemnity payments plus administrative expenses, incurred per exposure year in the obstetrician's county.	No effects	OLS and Probit	Obstetrics
Dubay et al. (1999) JHE	1990-1992 US	Malpractice pressure expressed through contemporaneous malpractice premiums for obstetricians. Malpractice premiums for neurosurgeons and state tort reforms used as instruments. As tort reforms, the authors consider: caps on total damages, caps on damages for P&S, time limits on discovery, discretionary pretrial screening, and mandatory pretrial screening	A high liability risk induces physicians to perform more c-sections especially for mothers of lower socioeconomic status. On the contrary, there is no effect with respect to neonatal health outcomes	FE models and IV	Obstetrics
Dhankhar et al. (2007) JELS	2002 US	Malpractice risk measured as frequency of paid claims (=the average of the number of claims paid in the three years (2000, 2001, and 2002) per 100,000 population of the state) and claims severity (=the mean amount paid per paid claim over the three years (2000, 2001, and 2002) in each state in $100,000s.)	An increase in medical malpractice risk leads to a reduction in resource use and improvement in health outcome for patients with less severe medical conditions. For patients with more severe medical conditions, medical malpractice is associated with an improvement in mortality.	Multinomial logit	Cardiology

Notes: JHE= Journal of Health Economics; JLE= Journal of Law and Economics; $JPube$= Journal of Public Economics; QJE= The Quarterly Journal of Economics.

Table 3: **Liability pressure and defensive medicine**

Study& Journal	**Period& Country**	**Policy**	**Results**	**Approach**	**Specialty**
Fenn et al. (2007) JHE	1995-2002 UK	Liability as expressed by the excess level paid under the pooling scheme	Hospitals facing higher expected costs per claim as a consequence of higher deductibles used these tests more frequently (*e.g.*, hospital with a 100,000 CNST excess used in the region of 74% more MRI scans and 43% more CT scans than hospitals with 50,000 excess), no real effect on routine exams	IV and GMM	X-rays, obstetric ultra-sounds, CT scans, MRI scans and fluoroscopy
Kim (2007) JLS	1990-2005 US	Malpractice risk as the number of ob-gyn claims per 1,000 births in each state over the last 3 years or the n of ob-gyn claims paid per birth in each state over the last 3 years	No effects	IV	Obstetrics
Frakes (2013) AER	1977-2005 US	Malpractice standards rule (controls for presence of tort reforms)	Adoption of national standard leads to a 40% reduction in the gap of c-sections between the state and national rate, similarly for cardiac procedures 30-45% of the gap between state and national rates is closed upon the change in law	OLS	Obstetrics plus cardiac treatments
Amaral et. al (2015) HE	2002-2009 Italy	Adoption of a experience-rate medical liability insurance	The probability of performing a C-section decreases by 7% up to 11.6% with no consequences for medical complications or neonatal outcomes	DD	Obstetrics

Notes: JHE= Journal of Health Economics; JLE= Journal of Law and Economics; $JPube$= Journal of Public Economics; QJE= The Quarterly Journal of Economics.

Outlines for Future Research

The importance of the liability system in explaining underuse or overuse of treatments is apparent. The risk of being sued does matter to healthcare providers. Therefore, study of the relation between medical liability and medical decisions can provide relevant policy implications for public debate. Given the challenges for empirical research, there are still several open questions that need to be answered. We identify at least four points that researchers approaching the topic should take carefully into account.

First, any empirical investigation of the topic needs a clear theoretical framework. Thus far, the more elaborated models are those provided by Currie and MacLeod (2008) and Shurtz (2014). Still, many papers disregard these models and keep testing the conventional wisdom that associate liability changes solely to variations in positive defensive medicine. This approach should be avoided for two reasons. First, it ignores the role of factors other than liability which affect the selection of medical treatments (*e.g.* the form and level of reimbursements, physicians' skills). Second, it often proxies changes in liability with policies for which the effect and/or the intensity of the effect in terms of liability pressure is not clear as in the case of damages caps.

Overall, more theoretical insights are needed on this topic. Only very recently have contributions begun to consider physicians' and hospitals self-awareness of their own skills (*i.e.*, over/under confidence). Similarly, the importance of reputation for doctors is universially recognized, thus the role played by reputational concerns in explaining why doctors want to avoid claims is always taken for granted. Still, such a role may differ in degree, depending on the institutional context: we could expect that reputational concerns of physicians operating in a public health care system, or working only for managed care, are different from the reputational concerns of physicians in private practices.

Second, the selection of the proper treatment to be used as the outcome of interest is crucial. Levels of hospital expenditures may be a quite fuzzy measure, as well as broad definitions of healthcare delivery (*e.g.*, hospital admissions, surgeries, or outpatient visits). Researchers should prefer treatments that have a direct counter-factual representing a more or less invasive procedure. Comparing the incidence of the two alternatives reduces the possible noise in the analysis, because it becomes possible to control for other factors influencing the medical choice such as financial incentives.

Third, hospitals do affect the decisions of the physicians they employ. So far, the vast majority of the existing literature fails to consider their role. A possible explanation for this deficiency is the focus on the US case study, where physicians tend to work in more than

one hospital. Nevertheless, the role of hospitals cannot be denied. As shown by the evidence from healthcare systems where physicians work only in one hospital (Fenn *et al.*, 2007; Fenn *et al.*, 2013; and Amaral Garcia *et al.*, 2015), healthcare organizations are quite effective in conveying their priorities to their employees. Therefore, investigation of the relations between hospitals and doctors may have important policy implications. Firstly, hospitals can be crucial to fight abuse of procedures and unnecessary expenditures. Secondly, hospitals may be a source of distortion in the selection of treatments if they favor objectives other than efficient provision of health care (*e.g.*, higher profit). In addition, there is a potential high heterogeneity on how hospitals influence medical decisions depending on their characteristics. The dynamics and interactions within a teaching hospital can differ substantially from those in a non-teaching hospital. Similarly, small and large hospitals provide different incentives to their employees. Physicians working in different types of structures can respond to the same variation in liability to different degrees. Failing to control for the hospital channel may muddle these differences and is a missed opportunity to discuss the design of policies targeted to healthcare structures.

Fourth, much more needs to be done to understand how the organization of the healthcare market can reinforce or offset the effect of a variation in liability. Empirical research should devote more effort to investigating what features of the market make physicians more or less responsive to changes in the risk of being sued. For example, recent literature has shown that more competition in the healthcare sector is able to foster the overall quality of the system (Gaynor, Moreno-Serra and Propper 2013; Bloom, Propper, Seiler and Van Reenen, 2015). How does competition affect the providers' reaction to changes in liability? If fiercer competition is linked to higher quality, then increasing the competition in the healthcare system could reduce the room for strategic selection of treatments done by practitioners.

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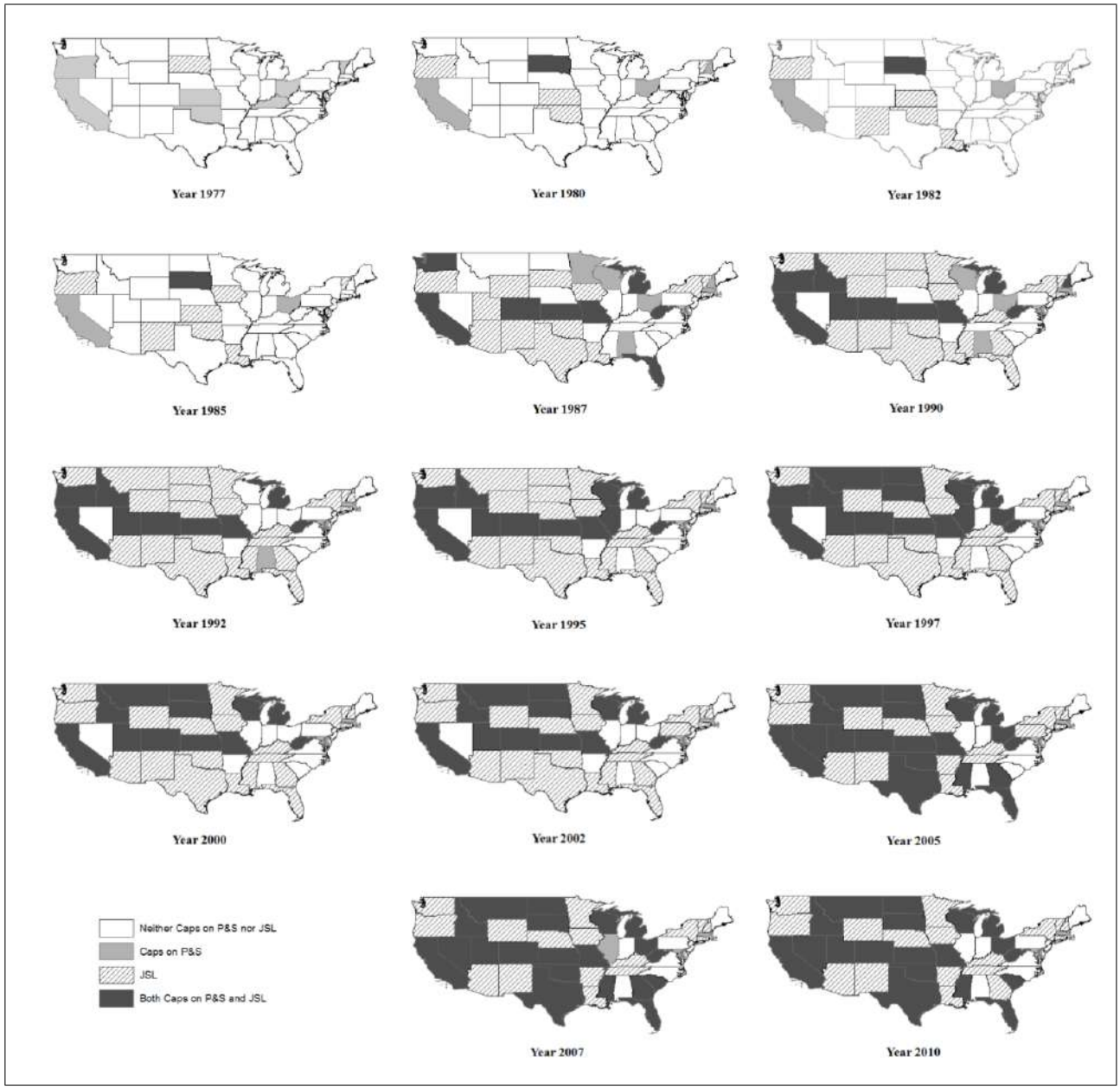
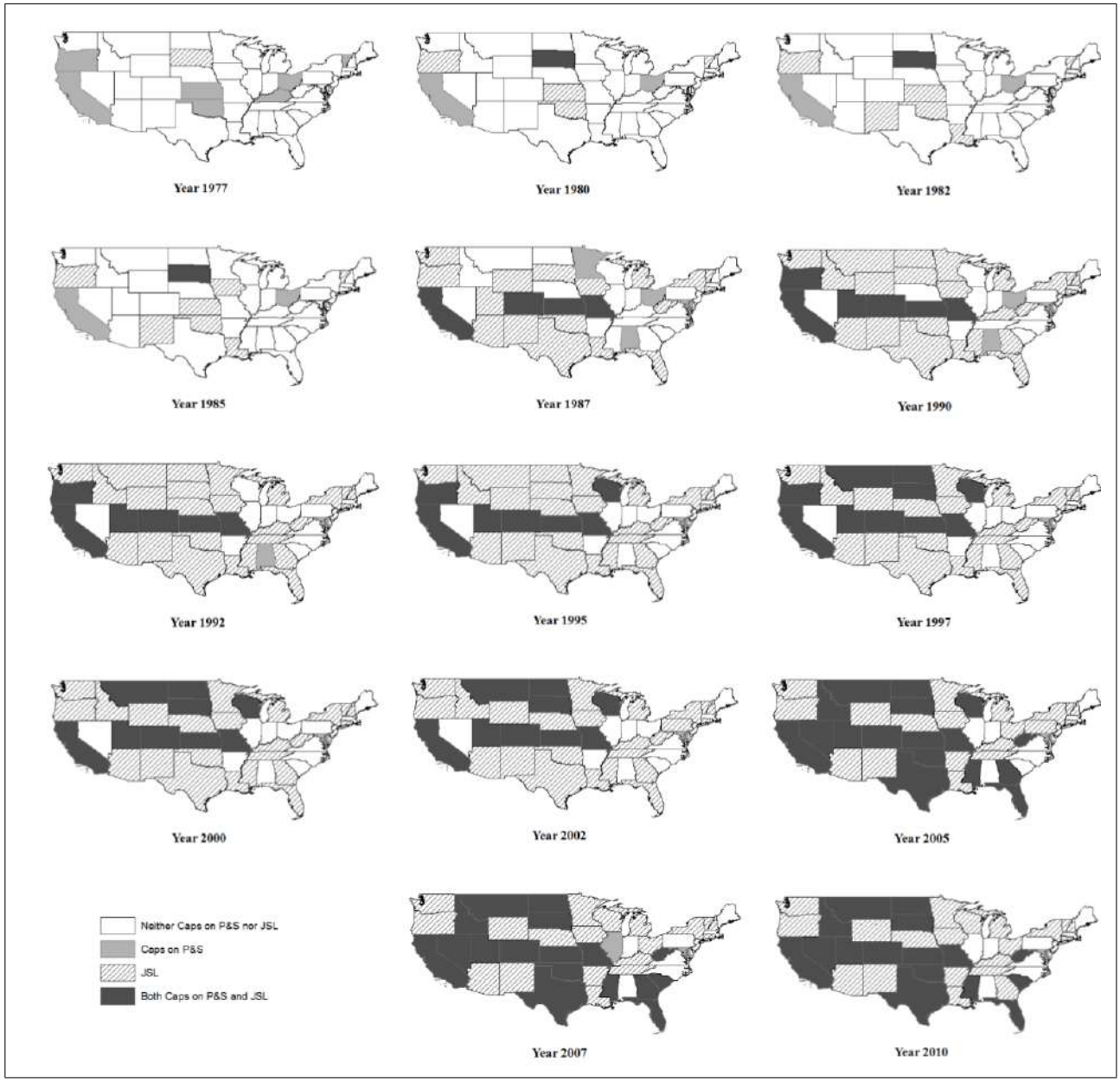
Figures

Figure 1: **Adoption of Caps on P&S and JSL in the US (1977-2010)**



Notes: Source Database of State Tort Law Reforms, DSTLR 5th (Avraham 2014). In white, states with no caps and no JSL. In light grey, states with caps on P&S. Dashed, states with JSL. Dark grey areas are the states with both caps on P&S and JSL.

Figure 2: **Adjusted Adoption of Caps on P&S and JSL in the US (1977-2010)**



Notes: Source Database of State Tort Law Reforms, DSTLR 5th (clever) (Avraham 2014). The DSTLR 5th (clever) differs from the DSTLR 5th as some tort reforms are turned off for different reasons such as caps on P&S being too high to bind. In white, states with no caps and no JSL. In light grey, states with caps on P&S. Dashed, states with JSL. Dark grey areas are the states with both caps on P&S and JSL.