OCCUPATIONAL LICENSING AND LEGAL LIABILITY: THE EFFECT OF REGULATION AND LITIGATION ON NURSE PRACTITIONERS, PHYSICIAN ASSISTANTS, AND THE HEALTHCARE SYSTEM

By

Benjamin J. McMichael

Dissertation

Submitted to the Faculty of the

Graduate School of Vanderbilt University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

in

Law and Economics

May, 2015

Nashville, Tennessee

Approved:

Professor James F. Blumstein

Professor Peter I. Buerhaus

Professor R. Lawrence Van Horn

Professor W. Kip Viscusi

To Hayley and Quentin

ACKNOWLEDGEMENTS

First and foremost, I wish to thank my beloved wife, Hayley, for her unwavering support and encouragement. None of this would have been possible without her. I thank the Vanderbilt Program in Law and Economics the generous financial, educational, and administrative support they have provided me during the last six years. I also wish to thank the individual members of my committee who have so generously given up so much of their time in support of my education. I thank my chair, Professor Larry Van Horn, for his constant support and nearly unending flow of ideas. I am grateful to Professor Kip Viscusi for introducing me to tort reform during my first summer as a graduate student and for his continuing encouragement since then. I appreciate Professor Peter Buerhaus for very generously providing his expertise and for his support in helping me present my ideas to others. Finally, I thank Professor Jim Blumstein for providing me with the background in health law necessary to write this dissertation.

I am also indebted to all of the members of the Law and Economics Program for their support, guidance, and input. Laurel Donahue and Amy Cates provided incomparable administrative support. I am particularly grateful to the following members of the Law and Economics Program for all of their dissertation-related help: Blair Druhan Bullock, Jake Byl, Elissa Gentry, and Caroline Cecot. This dissertation would not have become a reality without the constant and resolute support of my family. My parents and grandmother have provided invaluable support as I finished this dissertation following the birth of my son, Quentin. I also wish to acknowledge those individuals in my past who provided much of the guidance that led me to graduate school in the first place, including Professors Fred Chen and Jac Heckelman of Wake Forest University and two of my high school teachers, Gloria Boy and Carolyn Smothers.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

CHAPTER 2

CHAPTER 3

LIST OF FIGURES

CHAPTER 1

CHAPTER 2

LIST OF ABBREVIATIONS

AAFP: American Academy of Family Physicians

ACA: Patient Protection and Affordable Care Act

AHRF: Area Health Resource File

APN: Advanced practice nurse

BRFSS: Behavioral Risk Factor Surveillance System

CSR: Collateral source rule reform

DEA: Drug Enforcement Agency

FDA: Food and Drug Administration

FTC: Federal Trade Commission

HIPAA: Health Insurance Portability and Accountability Act

IOM: Institute of Medicine

JSLR: Joint and several liability reform

MD: physician or medical doctor

NGA: National Governors Association

NP: Nurse practitioner

NPPES: National Plan and Provider Enumeration System

NPI: National provider identifier

PA: Physician assistant

RX: prescription

INTRODUCTION

Congress passed the Patient Protection and Affordable Care Act (ACA) in 2010, and since that time millions of new patients have increased their demands on the healthcare system. While the ACA included several provisions designed to increase the supply of healthcare, the Act focused heavily on increasing individuals' ability to pay for care. Nurse practitioners (NPs) and physician assistants (PAs) represent two professions that can expand the capacity of the healthcare system to meet the increased demand in the wake of the ACA. Both of these professions require graduate level training in the provision of healthcare services, both practice in many of the same settings as physicians, and clinical evidence suggests that both provide safe care within their knowledge and training (Newhouse et al. 2011).

However, state occupational licensing laws restrict the ability of NPs and PAs to provide care. More specifically, state physician supervision laws require that all PAs and most NPs be supervised by physicians in order to practice. Additionally, state scope of practice laws limit the authority of NPs and PAs to prescribe medications to a greater extent than the authority of physicians. As the Institute of Medicine (2011) and National Governors Association (2012; 2014) have noted, these laws undermine the ability of NPs and PAs to expand the capacity of the healthcare system.

In addition to occupational licensing laws, NPs and PAs are subject to state tort law and may be sued for malpractice just like physicians and other professionals. However, when a patient sues an NP or PA, she may also be able to sue the supervising physician. Depending on state licensing laws, the patient may be able to sue the supervising physician directly (for some action the physician did or did not take) or under a theory of vicarious liability for the act or omission of an NP or PA. While patients can often sue a supervising physician, states require

that NPs and PA maintain separate malpractice insurance policies. These policies, like the malpractice insurance policies for physicians, are generally experience rated (not community rated), meaning that the premiums associated with the policy can increase based on the actions of the individual NP or PA.

When a patient sues an NP or PA, a court will determine whether her actions satisfied a reasonable standard of care. While some states consider what a "reasonable physician" would have done in similar circumstances and others consider what a "reasonable NP" or "reasonable PA" would have done, these standards should not differ in practice since the standard of care is, in theory, based on available medical evidence. The threat of malpractice liability can affect both the day-to-day medical decisions of professionals as well as their decisions of where to practice in the first place. Some states have enacted tort reforms, which are statutory modifications of traditional tort law, to ameliorate the perceived adverse effects of malpractice liability. The three major reforms include noneconomic damages caps, collateral source rule reform, and joint and several liability reform.

In this dissertation, I examine the effect of licensing and liability laws on NPs and PAs. Chapter 1 focuses on the determinants of licensing laws themselves. While prior work on licensing laws has attributed their passage to political idiosyncrasies, I consider the effect of the political strength of professional groups on states' decisions to pass licensing laws. Professional interest groups may engage in rent-seeking behavior to obtain laws that protect their own interests at the expense of other groups and, potentially, the public. I find evidence that licensing laws generally stem from a rent-seeking battle between physician interest groups, which support stricter licensing laws for NPs and PAs, and hospital interest groups, which support broader licensing laws for NPs and PAs. This evidence implicates future decisions on how to regulate the

healthcare workforce and suggests that the public should be wary of allowing professional groups to have a strong role in their own regulation.

Chapter 2 examines how licensing and liability laws affect the location decisions of NPs and PAs. In general, broader licensing laws increase the supply of NPs and PAs. Decreased physician supervision requirements increase the supply of NPs, and increased prescriptive authority increases the supply of PAs. In empirical models designed to the address the legislative endogeneity of licensing laws, I also find that increased prescriptive authority increases the supply of NPs and that allowing PAs to practice at sites away from their supervising physicians increases PA supply. Interestingly, while previous work on physician supply has found a relatively consistent, positive effect of noneconomic damages caps, I find that caps have complex effects on NP and PA supply while collateral source rule reform consistently increases the supply of NPs and PAs by around 20%.

Finally, Chapter 3 considers the effect of licensing and liability laws on healthcare quality. I consider the rate of medically appropriate and medically inappropriate cancer screenings as objective measures of healthcare quality. In general, neither NP nor PA licensing laws result in an unambiguous improvement or decline in healthcare quality. Instead, broader NP and PA licensing laws result in an indiscriminate increase in both medically appropriate and inappropriate cancer screenings when joint and several liability reform has not been enacted and an indiscriminate decrease when joint and several liability is in place. While these results suggest an ambiguous effect of licensing and liability laws on healthcare quality, they imply that NPs and PAs respond to the incentives created by malpractice liability and tort reform.

Overall, this dissertation provides insight into the effect of licensing and liability laws on the healthcare workforce and healthcare system. Professional interest groups themselves play a

meaningful role in determining the nature of the licensing laws that govern individual providers. This role is particularly important given the substantial effects that licensing laws can have on the supply of NPs and PAs and how they provide healthcare. These effects will become increasingly important as NPs and PAs take on greater roles in the healthcare system. Additionally, this dissertation provides the first evidence that malpractice liability and tort reforms can affect where NPs and PAs practice as well as how they provide care. I hope that this dissertation will provide useful evidence in the ongoing debate over how best to regulate the healthcare workforce.

CHAPTER 1

THE DEMAND FOR HEALTHCARE REGULATION: THE EFFECT OF POLITICAL PRESSURE ON OCCUPATIONAL LICENSING LAWS

I. Introduction

When a patient visits a medical clinic in the United States, she need not worry whether the physician, nurse, or other healthcare providers are charlatans selling snake oil to cure what ails her. State occupational licensing laws restrict who may provide healthcare to only those individuals who have obtained a license from the state, which in theory prevents low-quality providers from harming patients with substandard care. These laws also govern which healthcare professions may provide which services as well as how different professions interact with each other in the provision of care. While occupational licensing laws in healthcare are typically justified as necessary to protect the public health from the provision of harmful care, these laws may be used to protect the "turf" of one profession from encroachment by another. When occupational licensing laws are used to insulate professional groups from competition, they may harm the public health by barring access to services provided by competent professionals. In this chapter, I consider the role of professional interest groups in states' decisions to enact occupational licensing laws in the healthcare industry and find that stronger professional interest groups are better able to influence states to enact laws that benefit them.

With the passage of the Patient Protection and Affordable Care Act (ACA) in 2010, the healthcare system faces increased demand for care from newly insured and better insured patients. One mechanism to increase the availability and decrease the cost of healthcare services

is the increased use of Nurse Practitioners (NPs) and Physician Assistants (PAs) to provide those services. Both of these professions require advanced training in the provision of healthcare services, both provide many of the same services as physicians, and clinical evidence has demonstrated that within their knowledge and training, NPs and PAs can safely and competently care for patients (Newhouse et al. 2011; Laurant et al. 2009).

However, occupational licensing laws, which vary substantially across states, limit the scope of practice of NPs and PAs, restricting their ability to provide healthcare services. A number of national organizations, including the Institute of Medicine (IOM), the National Governors Association (NGA), and the Federal Trade Commission (FTC), have noted that states can increase access to healthcare and improve their healthcare systems by allowing NPs and PAs to practice to the full extent of their knowledge and training (IOM 2011; NGA 2012, 2014; Gilman and Koslov 2014). Additionally, the Supreme Court of the United States will decide a case in 2015 that will determine whether state licensing boards, which exercise substantial control over all healthcare professionals, will be exempt from antitrust scrutiny.[1] One of the main issues in the case is whether state licensing boards exercise their authority in the public interest.

In this chapter, I consider the role of politics and political spending in states' decisions to maintain different licensing laws governing NPs and PAs. The IOM and FTC have noted that licensing laws governing NPs and PAs are often driven more by politics than by scientific and clinical evidence (IOM 2011; Gilman and Koslov 2014). Consistent with Stigler's general hypothesis that "every industry or occupation that has enough political power to utilize the state will seek to control entry" (Stigler 1971, p. 5), states may be responsive to political pressure

[1] The case involves several nuanced questions of antitrust law that are beyond the scope of this paper, but one of the central questions in the case is whether state agencies are engaged in anti-competitive behavior when they restrict the provision of services to only certain professional license-holders. N. Carolina State Bd. of Dental Examiners v. F.T.C., 717 F.3d 359, 366-67 (4th Cir. 2013) cert. granted, 134 S. Ct. 1491 (2014).

from professional interest groups seeking to either protect themselves from competition (physicians) or decrease barriers to competition (NPs and PAs).[2] To test the idea that states maintain restrictive licensing laws in response to political pressure from professional interest groups, I use a dataset on state political campaign contributions to analyze the degree to which political spending by professional interest groups affects state occupational licensing laws. I gather detailed legal information on two types of occupational licensing laws for NPs and PAs—the degree to which states require physician supervision of their practices and whether NPs and PAs have essentially the same authority to prescribe medications as physicians.

I find that increased political spending by physician interest groups decreases the probability that states allow NPs and PAs to practice with more autonomy, i.e. less physician supervision. Increased spending by nurse groups increases the probability states allow NPs to practice with more autonomy. I also find that spending by interest groups associated with hospitals, which often support greater autonomy for NPs and PAs, increases the probability that NPs and PAs can practice with less physician oversight. Interestingly, spending by physician groups and hospital groups has a much larger impact on NP and PA licensing laws than spending by groups related directly to the interests of NPs and PAs. The results are consistent with a rent-seeking battle over licensing laws between physician groups and hospital groups.

This study is the first to quantify the effects of political spending on occupational licensing laws. Previous research has considered the effect of other institutional structures on the decision to maintain certain licensing laws, but I focus on direct measures of political strength (see, e.g., Meehan and Benson 2015; Stigler 1971). Prior work on NPs, PAs, and their effect on

[2] This is not to suggest that physicians are always the beneficiaries of these laws. In *North Carolina Board of Dental Examiners*, dentists benefit from the relevant licensing law. With respect to laws limiting the provision of certain hospital services only to registered nurses, states protect nurses from competition from other healthcare professionals.

the healthcare system has argued that occupational licensing laws governing NPs and PAs are the result of the idiosyncrasies of the political system, but the results presented here demonstrate that healthcare providers themselves play an important role in how states regulate the healthcare workforce. Evidence that occupational licensing laws are responsive to changes in the political power of the professionals they govern suggests that state governments do not necessarily regulate in the public interest but according to the interests of politically powerful groups.

II. Background and Literature

The NP and PA professions both emerged in the 1960s. NPs are registered nurses (RNs) who have completed additional training in order to diagnose and treat patients, order and interpret tests, and write prescriptions. Typically, NPs complete one to two years of additional study beyond the undergraduate level. PAs are healthcare providers who generally complete eighteen months to three years of training beyond an undergraduate degree, and they must typically possess some healthcare experience prior to beginning their training. Like NPs, PAs can order and interpret tests, diagnose and treat patients, and write prescriptions. NPs and PAs function similarly to physicians in a variety of settings and often perform as well or better than physicians in providing care within their education and training (Newhouse et al. 2011; Letz et al. 2004; Mundinger et al. 2000; Brown and Grimes 1995). Approximately 87,000 PAs and 135,000 NPs were licensed to practice in 2012. NPs and PAs currently outnumber family and general practice physicians, and many communities receive primary care services primarily from NPs and PAs (Auerbach 2012; Stange 2014).

However, they do not deliver care similarly in all communities because occupational licensing laws vary substantially across states. While these laws govern most aspects of an NP's

or PA's practice, two important categories of laws determine how they provide care to patients. Scope of practice laws determine what types of healthcare services NPs and PAs may provide, and supervision laws govern the level of physician involvement in NP and PA practices.

Three basic physician supervision requirements exist for NPs. Complete supervision laws require that an NP practice only under the supervision of a physician.[3] Prescription supervision laws allow NPs to practice without physician oversight, but they must have a supervisory relationship with a physician in order to prescribe medications to patients. Finally, some states allow NPs to practice independently of physicians.

While no state allows PAs to practice independently, states differ on the degree of physician involvement in PA practices. Similar to NPs, three basic supervision laws govern PA practices; however, the differences between the laws are more nuanced. "Onsite" supervision laws require that a physician be on the premises or within a certain distance, e.g. 30 miles, in order for a PA to see patients. Quasi-remote supervision laws allow PAs to routinely practice at a site separate from their supervising physicians but require that those physicians practice onsite or visit the site to provide supervision semi-weekly or more often. Finally, remote supervision laws allow PAs to practice at remote sites with onsite physician visits required no more than once a month; although, some states require only quarterly or bi-yearly visits.

While scope of practice laws limit many of the services NPs and PAs can provide, I focus specifically on the prescriptive authority of NPs and PAs since prescribing medications forms an integral part of most, if not all, NP and PA practices. For each provider group, I categorize states

[3] Some states use the term "collaboration" with a physician instead of "supervision" by a physician. While collaboration is often defined slightly differently, ostensibly providing for a more equal relationship, no practical difference exists between "collaborative" and "supervisory" relationships since the NPs must still maintain an association with a physician to practice. For ease of exposition, I do not distinguish between collaboration and supervision in my discussion of NP and PA licensing laws.

by whether they grant basically the same prescriptive authority to NPs/PAs as physicians. I classify states separately for NPs and PAs since they grant different prescriptive authority to each provider group at different times. States granting full prescriptive authority to NPs or PAs allow them to prescribe schedule II through V controlled substances with no, or only very minimal, additional restrictions beyond those imposed on physicians.[4] States not granting full prescriptive authority to NPs or PAs often prohibit them from prescribing schedule II and III controlled substances or limit them to only 72-hour emergency supplies of these medications.[5]

Figures 1 through 4 provide an overview of the changing landscape of occupational licensing laws governing NPs and PAs from 1999 through 2013. Figure 1 illustrates the changes in supervision laws for NPs. In general, states move toward greater NP autonomy with the number of states allowing independent NP practice increasing from ten to nineteen over a fifteen year period, with many of the changes occurring in the western states. A similar pattern exists for NP prescriptive authority as illustrated by Figure 2. Overall, granting NPs full prescriptive authority is more popular among states over this time period than is allowing NPs to practice independently.

Figure 3 illustrates the evolution of supervision laws for PAs. Two important patterns emerge from this and earlier figures. First, allowing PAs to practice remotely is more popular among states than allowing NPs to practice independently. Second, the pattern of adoption

[4] Controlled substances are medications that, while they have a medical use, may harm patients. Therefore, they are regulated by the Food and Drug Administration and the Drug Enforcement Agency to a greater degree than other prescription medications. These federal agencies classify relatively more dangerous medications into one of five "schedules." Schedule I medications have no accepted medical use and are banned. Drugs on the remaining schedules may harm patients but have accepted therapeutic uses. Generally speaking, the lower a drug's schedule, the more dangerous and addictive it is.

[5] If states require NPs or PAs to prescribe only from a state approved formulary of drugs, I classify those states as granting full authority or limited authority based on whether the formulary restricts entire schedules of controlled substances (limited authority) or not (full authority). Similarly, if a state prohibits NPs or PAs from prescribing only a few specific medications, I classify that state as a full prescriptive authority state.

among states granting PAs remote practice is different than the pattern of states granting NPs independent practice. This suggests that, in contrast to states simply granting more autonomy to healthcare providers in general or attempting to expand the supply of healthcare overall, states respond to different incentives, such as political spending, when deciding how to regulate their healthcare workforces, consistent with the conclusions of the IOM (2011).

It is important to note that the licensing laws I focus on throughout my analysis are primarily statutory, not regulatory. While regulations sometimes affect whether NPs and PAs possess full prescriptive authority and (less often) the degree of required physician supervision, statutes typically dominate these two areas of occupational licensing law. Additionally, state legislatures have demonstrated willingness in the past to overrule licensing regulations with statutes. Therefore, I do not, in general, consider the structure of licensing boards in my analysis.[6] However, these boards may wield substantial influence over other areas of occupational licensing laws (such as continuing education requirements) and may affect the strictness of physician supervision requirements or the breadth of NP and PA prescriptive authority to some degree.[7] Future work may examine the effect of different licensing board structures on occupational licensing laws similar to Meehan and Benson's (2015) analysis of different licensing board structures in the private security industry.

Prior work on occupational licensing laws in the healthcare industry has focused on the effects, not the determinants, of those laws. For example, Dueker et al. (2005) and Perry (2009) consider the effect of NP and PA licensing laws on the wages of NPs, PAs, and physicians. Later

[6] Including the structure of state licensing boards in my analysis would also likely raise endogeneity concerns since the state legislature controls the structure of licensing boards.
[7] For example, the District of Columbia passed a statute granting NPs full prescriptive authority but the relevant regulatory board refused to grant required drug enforcement agency numbers (which are required by federal law to prescribe controlled substances) to NPs until several years after the statute was passed.

work focuses on the effect of NPs and PAs on the market for healthcare services. Kleiner et al. (2014) find that when state laws allow NPs to perform more services without physician supervision, the price of a common medical examination decreases. However, Stange (2014) finds that an increase in NP and PA supply has only small effects on the office-based healthcare market but that healthcare utilization is more responsive to changes in the supply of NPs and PAs in states that grant broader licenses. Spetz et al. (2013) find that when patients visit retail health clinics, the total cost associated with an episode of illness/injury decreases and that this decrease is greater in states allowing greater NP authority. Kuo et al. (2013) find that NPs see more Medicare patients in states with broader licensing laws.

These studies elucidate the effects of licensing laws on providers and healthcare markets, but they do not examine the determinants of the laws themselves. Most studies appeal to the idiosyncrasies of the political system when discussing the adoption of different licensing laws (see, e.g., Stange 2014). Some studies attempt to confirm the exogeneity of licensing laws by regressing whether a specific law exists on economic (Kleiner et al. 2014) or economic and limited political factors (Traczynski and Udalova 2014). While Stange (2014) notes that changes in political power among professional groups could confound studies investigating the effects of licensing laws on different healthcare outcomes, no study has investigated the effect of political spending by professional groups on how states decide to regulate.

While the decision of how to regulate is obviously complex, two general theories attempt to explain states' regulatory decisions. First, the public interest theory of regulation posits that legislators pass laws that maximize public welfare. Because asymmetric information generally affects healthcare markets, occupational licensing laws may be justified as an intervention to

correct this market failure and enhance welfare.[8] For example, proponents of stricter licensing laws for NPs and PAs, such as the American Academy of Family Physicians (AAFP), contend that because NPs and PAs do not receive the same amount of training as physicians, legislators are justified in restricting their practices to protect the unknowing public from low-quality care. However, Leland (1979) notes that licensing laws that are set by the professions they purport to regulate are generally overly restrictive and often harm overall welfare. Leland's (1979) general conclusion appears to be relevant in the case of NP and PA regulation given that scientific and clinical evidence does not support the position that NPs and PAs provide harmful or low-quality care to patients with or without physician supervision (Newhouse et al. 2011).

In contrast to the public interest theory of regulation, the economic theory of regulation posits that professional (or industry) groups demand regulation that benefits them from the suppliers of regulation (legislatures and agencies) (Stigler 1971). Stigler (1971) hypothesizes that all professional groups will seek to use the power of the state to promote their own market power at the expense of other groups and the public.[9] He provides empirical evidence that the attributes of professions, such as their size and concentration in urban areas, affect how states license them. Later work has found evidence consistent with rent-seeking behavior driving regulations of specific industries and professions. For example, Meehan and Benson (2015) find that licensing laws in the private security industry are stricter when industry members are represented on licensing boards. De Figueiredo and Edwards (2007) find that telecommunications regulations are more favorable to entrant firms relative to incumbent firms when the proportion of political spending in the industry attributable to the former increases.

[8] While licensing laws can improve welfare, they are generally not a first-best solution (Leland 1979).
[9] Stigler (1971) focuses on a wider array of regulations than just occupational licensing laws, but licensing laws are one of the prominent examples in his general argument.

In the next section, I develop a model, based on Becker (1983), accounting explicitly for the role of political spending by different professional interest groups. This model, and the empirical analysis based on it, clarifies the effect professional interest groups have on the laws governing their practices.

III. Theoretical Framework

To examine individual states' decisions to regulate NPs and PAs, I use a mixed median voter and special interest group framework. This framework relies on the desire of politicians to gain or maintain their offices through election and re-election. The median voter theorem, originally developed by Black (1948) and Downs (1957), states that with two potential political outcomes and majority rule voting, the political system will choose the outcome preferred by the median voter. However, the median voter theorem requires a fairly strict set of assumptions to yield this prediction, and in practice, these assumptions may not be satisfied (Hinnich and Munger 1997; Stearns and Zywicki 2009).[10]

In contrast to the median voter theorem, the economic approach to political behavior posits that interest groups comprised of similarly minded individuals drive political outcomes based on their mutual self-interest and the pursuit of policies that further those interests (Stigler 1971; Becker 1983). This conceptualization of political behavior can be traced to Bentley (1908); although, later work by Downs (1957), Buchanan and Tullock (1962), and Niskanen (1971) formalized the idea that rent-seeking by interest groups plays an important role in the political

[10] For example, if the policy preferences of voters are not "single peaked," e.g., votes favor two extreme policies equally with a distaste for moderate policies, the median voter theorem does not yield the predictions described above. If voters must choose among more than one policy simultaneously, the median voter theorem does predict that politicians choose the median voter's outcome. Finally, if voters are not rational or are disinterested in the election, the median voter theorem may not yield useful predictions

system. Against this background, Posner (1971), Peltzman (1976), and Becker (1983), among others, analyzed the effect interest groups have on the regulations adopted by governments. In general, industry and professional groups seek regulations that benefit them at the expense of others, such as price fixing, entry restrictions, and subsidies. In return for beneficial regulation, interest groups offer campaign contributions or other benefits to legislators.

While later work has explored in more detail how interest groups arise and how they function within legislative bodies to accomplish a variety of goals (see, e.g., Denzau and Munger 1987; Baron 2001; Grossman and Helpman 1994; Persico 2014), Becker (1983) provides a straightforward model of the role of interest groups in the formation of policies designed to benefit group members. In this model, government policy requires a transfer from one group to another. This transfer is effectively a tax on the first group and a subsidy to the second, but this transfer could take the form of a regulation favoring the first group over the other. Olson (1982) specifically mentions licenses as a type of transfer that can benefit one group at the expense of another and result in a deadweight loss for society. In the case of NPs, PAs, and physicians, the transfer occurs when state governments impose restrictions on NPs and PAs beyond those required to ensure patient safety, which benefits physicians.[11]

Physician groups have an incentive to expend resources to maintain a system of regulation that benefits them at the expense of NPs and PAs while NP and PA groups have an incentive to combat this type of regulation. To capture the incentives and behavior of different groups, I develop a simple model based on both the median voter theorem and the Becker (1983) model of interest groups. In the model, legislators begin with the outcome most consistent with

[11] For example, by requiring that NPs function only under the supervision of physicians, a state government both protects physicians from competition with NPs and requires NPs to transfer direct payments to physicians for supervision services. NPs, as a group, are effectively taxed by this type of regulation while physicians are effectively subsidized.

voter preferences but deviate from that outcome consistent with interest group pressure. The model focuses on the dynamics between NP and physician interest groups, but the same analysis applies to the interaction between PA and physician interest groups.

Suppose that a legislature elected by majority rule voting consists of *L* legislators from *D* individual districts each consisting of *V* voters. The legislature is considering a regulation that would result in a net transfer, *R*, from NPs to physicians. Each legislator is self-interested, wishes to win re-election, and, therefore, chooses *R* to maximize her legislative support. For simplicity, assume each legislative district is identical and has exogenous voter preferences over the proposed transfer, *R*, given by $z \sim U[0, \alpha]$, where $\alpha > 0$. In the absence of interest groups, each legislator maximizes her electoral support by choosing $R = \bar{z} = \frac{\alpha}{2}$ since this is the choice of the median voter given the distribution of voter preferences.

When interest groups are present, they can influence legislative decisions by offering additional legislative support in the form of campaign contributions or by pressuring legislators in other ways. The model remains agnostic about the specific mechanism through which additional campaign contributions or pressure generates additional legislative support. Legislators may use additional funds from contributions in a variety of ways to increase their chances of re-election such as increasing the amount of advertising they purchase. In the presence of an NP and a physician interest group, legislators choose *R* such that

$$R = \bar{z} + I(p_m, p_n) \tag{1}$$

where $\bar{z}$ is defined as before and the function *I* is an influence function that depends on physician group pressure, p_m, and NP group pressure, p_n.[12] The influence function allows interest groups

[12] In this model, "pressure" can easily be replaced with "expenditure" to explicitly model the effect of additional political spending instead of pressure more generally.

to increase or decrease the size of the transfer by shifting the legislature's choice from the median voter's preferred $\bar{z}$. A legislator loses some electoral support by deviating from the median voter's choice, $\bar{z}$, but is compensated in additional support from the interest group(s). The influence function is increasing in p_m, so that $\frac{\partial I}{\partial p_m} > 0$, and decreasing in p_n, so that $\frac{\partial I}{\partial p_n} < 0$. The influence function also exhibits decreasing marginal returns to pressure so that $\frac{\partial^2 I}{\partial p_m^2} < 0$ and $\frac{\partial^2 I}{\partial p_n^2} > 0$.[13]

The utility of each interest group is given by:

$$U_m = M + g(R) - p_m \tag{2}$$

$$U_n = N - f(R) - p_n \tag{3}$$

where *M* and *N* are positive constants. I assume that the marginal cost of exerting an additional unit of pressure is 1. The functions *f* and *g* are the cost of collecting the transfer from one group and providing the transfer to the other group, respectively. As Becker (1983) explains, these functions capture the government's cost of transferring as well as the deadweight loss from the distorting effects of transfers. Because of inefficiencies in collecting the transfer, $f(R) \geq R$ for all *R*, and because of the inefficiencies in providing the transfer, $g(R) \leq R$ for all *R*. Because costs generally increase as the size of the transfer increases, $f'(R) \geq 1$, and $f''(R) \geq 0$. Similar inefficiencies may decrease the amount of the transfer that reaches the subsidized group as *R*

[13] In Becker's original model, each group influenced the amount of the transfer through a separate influence function. Using these two functions, he discusses "complementarity" between the optimal amount of influence exerted by each group as well as what happens if one group becomes relatively more efficient at exerting influence. In this model, I abstract away from explicitly addressing these issues, but both can be captured, to a lesser degree than by Becker's original model, by the specific form of the influence function as well as $\frac{\partial^2 I}{\partial p_m \partial p_m}$, which may be positive or negative.

increases so that $g'(R) \leq 1$ and $g''(R) \leq 0$, but an increase in the transfer should always increase the amount received by the subsidized group so that $g'(R) > 0$.

The two interest groups compete in a Cournot-Nash game, and like Becker (1983), I assume that each group acts as if the pressure exerted by the other group is unaffected by its own behavior. At the optimal level of expenditure for each group,

$$\frac{\partial I}{\partial p_m} = \frac{1}{\frac{\partial g}{\partial I}} \tag{4}$$

$$\frac{\partial I}{\partial p_n} = -\frac{1}{\frac{\partial f}{\partial I}}. \tag{5}$$

These conditions can be solved for equilibrium values of pressure by both groups. However, even without solving for equilibrium values of pressure, it is obvious that *R* must increase with an increase in p_m and decrease with an increase in p_n. For a fixed value of *z*, $\frac{\partial R}{\partial p_m} = \frac{\partial I}{\partial p_m} = \frac{1}{\frac{\partial g}{\partial I}} >$ 0 because $g'(R) > 0$ for all R. Similarly, for fixed *z*, $\frac{\partial R}{\partial p_n} = \frac{\partial I}{\partial p_n} = -\frac{1}{\frac{\partial f}{\partial I}} < 0$ since $f'(R) \geq 1$ for all R.

Neither group's optimal pressure depends on the median voter's preferences. Instead of solving for equilibrium values and comparing how the groups react when different aspects of the model change, I use the basic framework of this model to empirically test how the transfer between NPs and physicians (in this case, licensing laws) changes as interest group pressure changes. The two primary empirical predictions derived from the model are

$$\frac{\partial R}{\partial p_m} > 0 \tag{6}$$

$$\frac{\partial R}{\partial p_n} < 0. \tag{7}$$

As the pressure exerted by physician groups increases, the size of the transfer increases. Similarly, as the pressure exerted by NP groups increases, the size of the transfer decreases.

However, when examining the transfer from NPs and PAs to physicians, it is important to consider the nature of the licensing law effecting the transfer. In general, NPs and PAs will prefer the least restrictive supervision laws—independence for NPs and remote practice for PAs. These supervision laws increase the flexibility NPs and PAs have in meeting the demand for healthcare services. They will also tend to eliminate or reduce direct and indirect transfers from NPs and PAs to physicians (in the form or direct payments or lower wages) to secure supervisory services. On the other hand, NPs and PAs may or may not prefer full controlled substances authority. Full controlled substances authority necessarily includes schedule II controlled substances, which by definition have a high potential for abuse and which may lead to severe psychological or physical dependence. These drugs are the ones most often associated with drug-seeking behavior, severe side effects, and increased liability. NPs and PAs may want to avoid obtaining legal authority to prescribe these medications in an effort to avoid the problems associated with prescribing them, especially since these drugs may not be useful to many providers who practice in primary care and may not often need to use these drugs.[14] Physicians, on the other hand, may prefer that NPs and PAs possess full prescriptive authority if they possess any authority at all since this would relieve them from having to prescribe relatively dangerous drugs to patients they may not be very familiar with.[15] The next section details the data I use to test the effect of political pressure on occupational licensing laws.

[14] For example, most NPs and PAs in primary care may not often need to prescribe potent painkillers like morphine.
[15] Physicians likely see an increase in liability if they prescribe dangerous drugs to patients they are not very familiar with.

IV. Data

To test the effect of political influence on the licensing laws governing NPs and PAs, I consider the two different types of laws for NPs and PAs discussed above: supervision laws and scope of practice (prescriptive authority) laws. I classify states based on the different categories of supervision and scope of practice laws describe above and illustrated in figures 1 – 4. Table 1 provides a comprehensive overview of the changes in NP and PA supervision and prescriptive authority laws from 1998 through 2013. I limit my analysis to post-1998 because the Balanced Budget Act of 1997 authorized direct reimbursement through Medicare for the services of NPs and PAs beginning in 1998. Prior to 1998, Medicare only reimbursed NPs and PAs for providing services "incident to" physician services, meaning that even if they could practice independently, Medicare (and most private insurance companies) would not reimburse NPs and PAs for their services. After 1998, many private insurance companies followed suit in directly reimbursing NPs and PAs.

I obtained initial information on licensing laws from the annual legislative update provided in *The Nurse Practitioner* and several editions of *Physician Assistants: State Laws and Regulations*. I augmented this information with direct statutory and regulatory research using Westlaw and its associated products. Examining the actual statutory and regulatory language in different states and years allowed me to consistently code state laws without having to rely on different secondary sources which may not provide consistent statutory interpretation.[16] My final classification of NP laws is consistent with that of Traczynski and Udalova (2014) and Kleiner et

[16] As noted above, supervision laws and scope of practice laws are predominantly statutory. When classifying laws, I examine both relevant statutes and regulations. To be classified in a particular category, both a state's statutes and regulations must be consistent with that category. If the statutes and regulations are not consistent, I place a state into the legal category consistent with the most restrictive law, whether that law is based on a statute or regulation. For example, if a state statute allows independent NP practice but a state regulation requires supervision, I classify the state as requiring supervision until the regulation is repealed or overruled by a court.

al. (2014); although, it differs slightly on the first year of applicability for some states.[17] No other research has generated a similar list or database of PA laws, so I am unable to compare my classification with others in the literature.[18]

I proxy for the amount of political pressure exerted at the state level by different interest groups with campaign contributions made by those groups to candidates in state elections. Data on campaign contributions come from the National Institute on Money in State Politics and were collected from required disclosures made by donors for all state primary and general elections.[19] The Institute assigns each contribution an economic interest code based on the nature or purpose of the interest group making the contribution. For healthcare professionals, the Institute classifies donors into nine subcategories, including physicians, nurses, non-physician health practitioners, and other physician specialists. I group the two categories "physicians" and "other physician specialists" into one category and maintain the Institute's classifications for nurses and non-physician practitioners.

For each of these three professional groups—physicians, nurses, and non-physician practitioners—I define a professional group's "clout" in a given state and year as the sum of political spending by interest groups connected with that profession per 1,000 state residents. I am not able to discern the purpose of individual contributions, so the amount of money spent in a given state and year represents the general political strength of a professional group as opposed to a group's spending on any given issue. Nurse contributions are not unique to NPs, but in general, the greatest amount of support for greater NP authority comes from nurse organizations.

[17] If a new state law took effect in the latter part of a given year, I coded it as taking effect in the next calendar year to allow groups to acclimate to the new law.
[18] The papers that have coded PA laws did not reveal that coding in the published versions.
[19] The Institute has collected data on all primary and general elections since 2000 and has information on most states going back well into the 1990s.

Additionally, any organizations specific to NPs are included in the broader "nurse" category. The category "non-physician health practitioners" is not unique to PAs, and it is not possible to unambiguously disaggregate the spending by different groups in the non-physician category.[20] However, PA interests, along with physical therapist interests, dominate this category of spending. In addition to spending by these three professional groups, I also obtained information on state-level spending by hospitals and other healthcare institutions. As noted by Feldstein (2011), among others, hospitals and nursing homes often support more liberal licensing laws because with these laws, they can employ additional NPs and PAs at a lower cost to provide services otherwise provided by physicians.[21]

Table 2 reports summary statistics for the clout of different professional groups as well as other variables used throughout my analysis. On average, per capita spending by physician groups and hospital groups is twenty times greater than spending by nurse groups and non-physician practitioner groups. As a number of researchers, including De Figueiredo and Edwards (2007), have noted, politicians like to avoid the appearance of selling their votes. Therefore, the contributions of any given group are likely not rewarded immediately, but politicians may promote the interests of contributing groups over time. To account for this long-term effect, I use the natural logarithm of two-year, three-year, and four-year totals of political clout beginning with the year immediately preceding the year a new licensing law first takes effect.[22]

[20] For many contributions, it is possible to determine if a contribution is attributable to a PA group. However, for a number of organizations with ambiguous names, it is not possible to discern their professional affiliation without further information. Because I am not able to accurately discern the affiliation of many of the groups in the non-physician healthcare provider category, I include the category as a whole.

[21] Unfortunately, I do not observe political contributions unique to retail pharmacies or other healthcare companies that may have an interest in retail health clinics. These firms may prefer broader NP and PA licenses as a means to increase the profits from retail health clinics (see Spetz et al. 2013).

[22] In practice, the first year a licensing law is coded as taking effect is usually the calendar year following its enactment.

In general, I expect that the four-year total will best capture the effect of changes in political clout since this total includes at least one election in the majority of state legislatures and generally includes two elections in the lower houses of state legislatures. Four-year totals also better capture the effect of legislators' influence over regulatory agencies whose members are often appointed for specific terms. Because of the limited data on political spending further back into the 1990s and because I calculate sums of the four previous years, I limit my analysis to 1999 and later. Additionally, because I calculate the natural logarithm of all clout variables, I add one to the total spending of each professional group in each state-year.

To proxy for the median voter's preferences on licensing laws, I collected information on a variety of state characteristics. The median voter theorem and its associated predictions rely on exogenous voter preferences, and I argue that the characteristics discussed here are exogenous with respect to licensing laws but proxy for the preferences of individual state voters. First, information on the number and percentage of each state's population covered by private health insurance, Medicare, Medicaid, or other health insurance programs come from the United States Census Bureau. Table 2 reports summary statistics for the percentage of state residents covered by different types of insurance. Individuals with private insurance may prefer that NPs and PAs possess broader licenses because they can provide services more cheaply than physicians. Individuals with government health insurance may face lower costs of accessing care (e.g., travel time, travel costs, wait times, etc.) when NPs and PAs can provide more services without physician supervision.

Using population data from the Census Bureau and land area data from various state sources, I construct a population density variable. Individuals in sparsely populated states may prefer broader NP and PA licenses because they may be unable to access physician-provided

care in rural areas. Data on the median income and the fraction of a state's population that identifies as black for each state and year also come from the Census Bureau. States with relatively more affluent residents may not favor broader licenses for NPs and PAs if they prefer to obtain healthcare from physicians and have less difficulty paying for relatively more expensive care. If a racial bias makes it more difficult for African Americans to access healthcare, then states with greater proportions of African Americans may favor broader licensing laws to ameliorate this bias. Finally, information on the party of state governors comes from the Indiana State University Center for Governmental Services. Prior work has demonstrated that states with democratic governors are more likely to have broader NP and PA licensing laws (Perry 2009).[23] Based on the Democratic Party's general support of increased access to healthcare, democratic governors may be more sympathetic to healthcare access issues and therefore favor broader licensing laws.

In addition to using these state characteristics to proxy for exogenous voter preferences for NP and PA licensing laws, I also obtained information on state tort reforms from the Database of State Tort Law Reforms (DSTLR 4th) compiled by Avraham (2011) because licensing laws represent only one way healthcare providers are regulated. Medical malpractice law and the deterrence it exerts on healthcare providers represents an important parallel regulatory mechanism to licensing laws. Because of its role in regulating providers, I control for the effect of tort reforms in my empirical analysis. I control for three types of tort reforms that are generally regarded in the malpractice literature as the three major reforms (see, e.g., Avraham and Schanzenbach 2010). Noneconomic damages caps prohibit courts from imposing damages for noneconomic harms like pain and suffering greater than the cap amount. Collateral source

[23] However, Traczynski and Udalova (2014) find that democratic governors are associated with an increased time to adoption of full NP independence in the 18 states that adopted independence by 2011.

rule reform allows courts to reduce the amount of damages a defendant must pay by the amount received by the plaintiff from alternative sources to cover her expenses related to the injury, such as her health insurance. Joint and several liability reform prohibits plaintiffs from recovering the entire damages award from a single defendant when a court finds multiple defendants liable.

V. Empirical Approach and Specification

I estimate the relationship between a state's decision to enact NP and PA licensing laws, political spending by professional groups, and voter preferences. Let L_{st} be an indicator for whether state *s* has enacted a given licensing law in year *t*. Here, L_{st} corresponds to the transfer, *R*, above. Unlike traditional transfers, licensing laws are binary outcomes instead of continuous. Therefore, instead of the transfer assuming any value based on voter preferences and interest group pressure, a transfer in the form of a licensing law equals one if preferences and pressure are greater than some threshold amount, γ. In general, let $L_{st} = 1$ when a state has adopted a more liberal licensing law allowing NPs and PAs to perform more services or perform services with less supervision. Let Z_{st} be a vector of state demographic characteristics that proxy for voters' exogenous preferences for licensing laws, and let I_{st} be a vector of political clout of interested professional groups, which proxies for the pressure they exert. The relationships I estimate are summarized by the following equation:[24]

$$\Pr(L_{st} = 1) = \rho(Z'_{st}\gamma_1 + I'_{st}\gamma_2 > \gamma). \quad (8)$$

To estimate the effects of political campaign contributions and voter preferences on state licensing law outcomes, I use linear probability models with the following general specification:

[24] I do not examine which laws will be adopted for the first time in a given time period. Doing so would require information on states prior to the adoption of any laws granting NPs and PAs authority to practice which does not exist for my measures of political pressure.[24] Instead, I examine whether licensing laws are consistent with voter preferences and political pressure similar to the approach taken by Hersch, Del Rossi, and Viscusi (2004).

$$L_{st} = \alpha + \beta_1 \log(Nurse\ clout)_{st} + \beta_2 log(Physician\ clout)_{st} + \beta_3 log(Hospital\ clout)_{st} + (Torts)'_{st}\delta_1 + (Insurance)'_{st}\delta_2 + (Demographics)'_{st}\delta_3 + \theta_s + \theta_t + \varepsilon_{st}\ . \quad (9)$$

$L_{st}$is an indicator for a specific licensing law in state *s* in year *t*. The first three variables on the right hand side correspond to the clout of professional groups while the rest of the variables proxy for voter preferences, control for alternative regulatory mechanisms, and control for state and time fixed effects. Throughout my analysis, I estimate separate models to include three different temporal measures of political clout. First, I use the natural logarithm of the relevant interest group's spending per capita for the two years immediately preceding a given year. Next, I use the natural logarithm of each group's spending for the previous three and four years. In general, the models including four-year measures of clout are the preferred specifications because they best capture the influence of professional groups as discussed above. When the licensing law under consideration governs NPs, I use a measure of nurse clout. When the licensing law under consideration governs PAs, I replace this with a measure of non-physician provider clout.

$Torts_{st}$ is a vector of three indicator variables for whether state *s* had enacted a noneconomic damages cap, collateral source rule reform, and joint and several liability reform in year *t*. I include these variables to control for alternative mechanisms of regulating healthcare professionals. $Insurance_{st}$ is a vector that includes the percentage of the state population covered by private insurance, the percentage covered by a state Medicaid program, and the percentage covered by Medicare. The $Demographics_{st}$ vector includes an indicator for whether the state had a democratic governor, the population density of the state, the natural logarithm of the median income for the state, and the percentage of a state's population that identifies as black. Collectively, the variables included in the $Insurance_{st}$ and $Demographics_{st}$ vectors

proxy for the median voter's preferences for licensing laws as discussed above. To control for fixed, unobserved determinants of licensing laws over time and across states, I include a vector of state, θ_s, and time, θ_t, fixed effects.

The key parameters of interest, β_1, β_2, and β_3, represent the change in the probability of a state adopting a given licensing law associated with an increase in the clout of different professional groups. Throughout my analysis, I employ linear probability models with state and time fixed effects.[25] Linear probability models may be preferable to probit and logit models because the latter two can lead to identification by functional form and suffer from the incidental parameters problem identified by Neyman and Scott (1948). However, I also estimate rank ordered logit models where the dependent variable is a ranking of physician supervision laws because these models can accommodate a multi-tier dependent variable.

VI. Results for State Occupational Licensing Laws

I begin by estimating the effect of voter preferences and interest group pressure on physician supervision laws. Starting with supervision laws for NPs, Table 3 reports results from linear probability models for whether NPs are allowed to practice independently of physicians. In all specifications, the dependent variable is an indicator for whether a state allows independent NP practice in a given year. All three columns include the same voter preference and tort reform variables but include different measures of political clout. Column (1) reports estimates using the logarithm of the two-year total of interest group clout, Column (2) reports estimates using the three-year total, and Column (3) reports the preferred specification with the four-year total.

[25] Because I have information on all 50 states and the District of Columbia from 1999 through 2013, I have a balanced panel. For balanced panels, the inclusion of state and time indicators in a linear model is equivalent to estimating a true fixed effects model.

Focusing on the preferred specification in column (3), which includes the measure of political clout over the long term, nurse, physician, and hospital clout have a statistically significant effect on whether a state allows independent NP practice. Consistent with the predicted effects, an increase in nurse and hospital clout increases the probability of NP independence while an increase in physician clout decreases the probability a state grants NPs more autonomy. The effect of an increase in physician and hospital clout are 9 and 7 times larger, respectively, in magnitude than the effect of an increase in nurse clout. A 10% increase in the four-year total of nurse clout leads to a 0.11 percentage point increase in the probability a state allows NPs to practice independently. The probability that a state allows NP independence decreases by 0.95 percentage points when physician clout over four years increases by 10% and increases by 0.77 percentage points when hospital clout increases by 10%.

Overall, hospitals and physicians wield relatively more influence over whether a state allows NP independence than nurses do. While the estimated effects are not large in magnitude, they do represent meaningful changes in the probability states allow NP independence. For example, in 2013, 19 states allowed NPs to practice without supervision. Using 0.38 as a rough probability of NP independence, a 10% increase in physician clout decreases this probability by 2.5% and a doubling of physician spending decreases this probability by 25%. With an average spending of about $26 per 1,000 state residents, a 10% increase in physician spending in Kentucky (the median state in terms of population) represents only a total increase in spending by physician groups of about $11,500 across *all* state elections. This is a relatively small amount and represents less than 10% of the income of the average physician.

States also respond to changes in voter preferences. Focusing on column (3), the probability that a state allows NP independence increases by 1.3 percentage points for every one

percentage point increase in private insurance coverage, by 1.2 percentage points for every one percentage point increase in Medicaid coverage, and by 1.5 percentage points for every one percentage point increase in Medicare coverage. Similarly, having a democratic governor and a higher fraction of black residents leads to a statistically significant increase in the probability a state allows NPs to practice independently. Additionally, the presence of alternative regulatory schemes affects the probability states allow NPs to practice independently. Noneconomic damages caps increase and collateral source rule reform decrease this probability, respectively.

Table 4 reports linear probability model estimates for the effect of political pressure and voter preferences on whether states require physician supervision of NP prescribing (prescription supervision). Because prescription supervision represents an intermediate level of supervision between independence and complete supervision, I drop all (19) states that ever allow NP independence. A positive estimated coefficient implies that a particular variable is associated with an increase in the probability a state chooses a less restrictive supervision law (prescription supervision) relative to a more restrictive law (complete supervision). Focusing on the preferred specification in column (3), the estimated coefficients for physician and hospital clout are not statistically significant, and an increase in nurse clout leads to an increase in the probability a state chooses a less restrictive supervision law, consistent with the predictions discussed above and the estimated effect in Table 3.

To confirm that an increase in the political clout of different groups has a consistent effect across the range of supervision laws, I estimate logit models using the full sample of states and years. To account for state fixed effects, I estimate fixed effect logit models based on the conditional likelihood function (see Chamberlain 1980). Rank ordered logit models are generalizations of fixed effect logit models that can accommodate dependent variables with a

ranked, but non-binary, structure (see Hausman and Ruud 1987). In these models, the dependent variable is a ranking of supervision laws from least to most restrictive. With this dependent variable, rank ordered logit models can estimate the effect of moving to a less restrictive law given other alternatives. I include state fixed effects, and while I cannot also account for time fixed effects, I include a set of indicator variables for different years. Because of the way the rank ordered logit model is estimated, it is not possible to include all of the control variables used in the above analysis in a single specification.

Table 5 reports the results from three rank ordered logit models. The dependent variable in all specifications is a ranking from least restrictive to most restrictive NP supervision regimes. Column (3) reports the preferred specification using four-year totals of political clout. Consistent with earlier results for NP independence, an increase in physician clout results in a decrease in the probability a state chooses a less restrictive supervision regime while an increase in hospital clout generates an increase in this probability.

Overall, both political pressure and voter preferences play a role in whether a state has enacted less restrictive supervision laws for NPs, and the same is true in general for PA supervision laws. Table 6 reports the results from three linear probability models estimating the effect of pressure and preferences on the probability a state allows PAs to practice remotely. As with independent NP practice, an increase in physician clout leads to a decrease in the probability that a state allows remote PA practice, and an increase in hospital clout leads to an increase in the probability of remote practice. The magnitudes of the effects of physician and hospital clout are smaller for remote PA practice than independent NP practice, but the effects are statistically significant whether clout is measured over two, three, or four years. In general, a 10% increase in physician clout results in slightly less than a 0.5 percentage point decrease in the

probability a state allows remote PA practice while a 10% increase in hospital clout leads to slightly less than a 0.6 percentage point increase in the probability of remote practice. An increase in non-physician clout leads to a decrease in the probability of a state allowing remote PA practice. However, this result may stem from the fact that non-physician clout is not unique to PAs. For example, if physical therapist interests conflict with PA interests so that they oppose remote PA practice, then an increase in non-physician clout could lead to a decrease in the probability of remote PA practice.

Voter preferences also affect the probability a state allows remote PA practice. Unlike independent NP practice, the percentages of people covered by private insurance and Medicaid do not influence the probability of remote PA practice. An increase in the percentage of individuals covered by Medicare, however, leads to a statistically significant decrease in the probability a state allows remote practice. Like independent NP practice, democratic governors increase the probability of remote PA practice. In all specifications, the coefficient on population density is positive and statistically significant, implying that more densely populated areas are more likely to have remotely practicing PAs. Additionally, the presence of noneconomic damages caps and collateral source rule reform decrease the probability PAs may practice remotely.

Table 7 reports results from linear probability models with an indicator for whether a state allows quasi-remote PA practice as the dependent variable. Because quasi-remote practice is an intermediate level of supervision between remote practice and onsite supervision, columns (1) through (3) report results from specifications with all states that ever allowed remote PA practice omitted. In these specifications, increases in physician and hospital clout consistently result in a decrease and increase, respectively, in the probability a state allows quasi-remote PA

practice (relative to onsite supervision). These results are consistent with the results for remote PA practice.

To confirm that these results hold for the entire sample of states, I estimate rank ordered logit models with a ranking from least to most restrictive PA supervision laws as the dependent variable. These models are similar to the ones used for NP supervision laws, and the results are reported in Table 8. Across all three temporal measures of political clout, an increase in physician clout decreases the probability that PAs may practice with more autonomy while an increase in hospital clout increases this probability.

Turning to scope of practice laws (i.e., NP and PA prescriptive authority), Table 9 reports the regression results for NP controlled substances authority. The dependent variable in all specifications is an indicator for whether NPs may prescribe all controlled substances, i.e., whether they have essentially the same prescriptive authority as physicians. Similar to supervision laws, both political pressure and voter preferences influence whether a state grants NPs full prescriptive authority. However, the estimated effect of an increase in clout by each group is contrary to the predicted effect. As noted above, existing NPs may prefer limited controlled substances authority to full authority as means of avoiding the problems associated with relatively more dangerous drugs. For example, NPs, the majority of whom practice in primary care, may have little need for potent painkillers and may wish to avoid the additional regulatory burdens and increased liability that necessarily comes with the authority to prescribe these and other schedule II controlled substances. Physicians, on the other hand, may prefer that NPs possess full prescriptive authority if they possess any authority since this would relieve physicians of the responsibility and liability of prescribing relatively dangerous drugs to patients with whom they may not be very familiar.

Voter preferences also play a role in states' adoption of full prescriptive authority for NPs, although, not as big of a role as in the adoption of less restrictive supervision laws. Only the presence of a democratic governor is consistently statistically significant. However, an F test of joint significance confirms that the remaining voter preference proxies are jointly significant.

Finally, no evidence suggests that political pressure affects whether states grant PAs full prescriptive authority as demonstrated by Table 10. While the signs of the estimated coefficients are consistent with PAs and hospitals pressuring states for more authority and physicians for less, none of the effects are statistically significant. On the other hand, voter preferences do influence whether states allow PAs to prescribe essentially the same medications as physicians. An increase in Medicaid coverage leads to a decrease in the probability of full PA prescriptive authority while an increase in median income and population density generate increases in the probability of full authority.

VII. Discussion

Overall, the estimated results demonstrate that both political pressure by professional interest groups and voter preferences affect whether states adopt different licensing laws. An increase in physician clout decreases the probability of states allowing the highest level of NP and PA autonomy (independent and remote practice, respectively). These results are consistent with the theoretical predictions of the model. Physicians, as a group, seek to maintain governmental transfers from NPs and PAs to themselves in the form of stricter supervision requirements by pressuring state legislators. Similarly, the evidence demonstrates that NPs, as a group, pressure legislators to eliminate or reduce this transfer by enacting broader licensing laws. However, the effect of an increase in NP clout results in a much smaller change in the probability

that a state allows independent practice than a commensurate percentage increase in physician clout. Within the model, this may reflect relatively less efficient pressure by NPs; although, a specific test of this would require additional data on how well different groups are organized.

PAs, insofar as they are captured by the measure of non-physician clout, do not have the same effect on their own legal outcomes as NPs have on theirs. However, hospitals, which are subject to an indirect transfer from themselves to physicians when they cannot hire relatively autonomous NPs and PAs, consistently favor broader licensing laws for both NPs and PAs. The evidence for hospitals is consistent with their being as efficient at pressuring legislators as physicians since the effect of an increase in hospital clout is similar in magnitude to the effect of a commensurate increase in physician clout. In fact, given the size of the estimated effects, the "battle" over NP and PA licensing laws is better characterized as a rent-seeking battle between hospitals and physicians as opposed to NPs/PAs and physicians.

Voter preferences also play a role, and interestingly, they sometimes play different roles in NP and PA licensing laws. For example, an increase in any type of insurance coverage leads to an increase in the probability a state allows NPs to practice independently, but only a change in Medicare coverage affects the probability a state allows remote PA practice (and this effect is negative). Democratic governors almost always favor greater autonomy for NPs and PAs. Similar to voter preferences, the presence of different tort reforms affects NP and PA licensing laws, but the effects differ across licensing laws. For example, the presence of noneconomic damages caps increases the probability of NP independence but decreases the probability of remote PA practice.

In general, the results of the empirical analysis are consistent with self-interested behavior by professional groups and the state legislators regulating them. If state legislators

actually regulated in the public interest, increased political spending by any group should not affect the legislature's choice of occupational licensing laws. One could imagine a scenario in which only a desire that states maximize patient safety and access to healthcare motivates professional groups. Perhaps groups simply spend money to educate state legislators on the best way to benefit patients by providing information. However, if this were the case, I would expect to observe similar coefficients on the spending by each group or, at the very least, estimated coefficients with the same signs. I do not observe these effects, which implies professional group political spending is motivated by the desire to maximize benefits for group members.

The evidence demonstrating that states do not choose occupational licensing laws based on the public interest and that professional groups use their political clout to obtain laws favorable to their members implicates the Supreme Court's upcoming decision in *North Carolina Board of Dental Examiners* and professional regulation more generally. If states do not regulate in the public interest and professional groups protect their own members at the expense of others, courts should be wary of allowing substantial roles for professional groups in directly regulating their members. Additionally, part of the original antitrust doctrine exempting certain state actors, like licensing boards, from antitrust scrutiny is predicated on the assumption that these actors regulate in the public interest. The evidence presented here undermines that assumption to a significant degree.[26] However, it is relevant to note that the occupational licensing laws considered in this chapter are primarily statutory, not regulatory, meaning the Supreme Court decision will not affect them directly.

[26] On the other hand, evidence that political spending on state elections influences states' choices of occupational licensing laws suggests that state legislatures themselves exercise some control over state licensing boards. The degree of this control is an important issue in whether the boards should be exempt from antitrust scrutiny. If the boards acted independently of state legislatures, I would estimate zero coefficients for the effect of professional group spending in state elections on occupational licensing law choices. The fact that I estimate statistically significant coefficients suggests that legislatures play a role in supervising licensing boards.

In addition to illustrating how professional groups affect occupational licensing laws, the results presented here also provide greater context to the downstream effects of those laws. Prior work has characterized the decision of how to regulate NPs and PAs as exogenous or plausibly exogenous based on the idiosyncrasies of the political system (Stange 2014; Traczynski and Udalova 2014; Kleiner et al. 2014). While the political system may be idiosyncratic to some degree, the evidence presented here demonstrates that state regulation of NPs and PAs responds to changes in political pressure both by professional interest groups and through voter preferences.

VIII. Extensions and Robustness

The analysis presented above is based on Becker's model of interest group behavior and the median voter theorem. However, economists and political scientists have developed other models of legislative and interest group behavior. Baron (2001) developed one popular approach to modeling interest group behavior that differs from Becker's.[27] In this model, interest groups battle each other over a specific policy decision through campaign contributions. The policy decision under consideration is particularly important for the interest groups but does not generate much interest from a wider political audience. Because the decision primarily affects only a few groups, relative (as opposed to absolute) contributions by different interest groups drive the policy decision. This model could plausibly capture the decision of how to regulate NPs and PAs because, as Feldstein (2011) notes, licensing laws can generate concentrated interests among healthcare professionals but only diffuse interests among other voters.

[27] Baron's (2001) model was based on earlier work by Bernheim and Whinston (1986) and Grossman and Helpman (1994).

De Figueiredo and Edwards (2007) use this model as the basis of their analysis of how campaign contributions affect regulatory outcomes in the telecommunications industry, and they find that regulations are friendlier to new entrant firms relative to incumbent firms as the proportion of total telecommunications spending attributable to entrant firms increases. To test whether the results described above are unique to the underlying theoretical model based on Becker (1983), I employ a similar empirical strategy as De Figueiredo and Edwards (2007). I construct relative spending variables relevant to NP licensing laws and PA licensing laws. For NPs, I divide the sum of spending by nurse and hospital interest groups by the sum of nurse, hospital, and physician interest groups to calculate the proportion of spending attributable to groups that favor broader NP licensing laws. For PAs, I do the same but replace nurse spending with non-physician practitioner spending. I refer to the nurse and non-physician proportional spending variables as *Nurse proportion* and *Non-physician proportion*, respectively.

As with the clout measures discussed above, I calculate the proportion of total spending attributable to nurse and non-physician groups (plus hospital groups) over the previous two, three, and four years. I use the same general specification described above but replace the clout variables for different groups with proportional spending variables. The results are reported in the Appendix. Table A1 reports results with an indicator for NP independence as the dependent variable. The results are consistent with earlier estimates. An increase in the proportion of spending attributable to NP-friendly groups results in an increase in the probability that a state allows independent NP practice. Interestingly, the estimated coefficients are statistically significant across all three temporal measures of nurse proportion. Table A2 reports results for supervision laws governing PAs. The estimated effects of political spending on whether PAs

may practice remotely are consistent with previous results. An increase in the proportion of non-physician spending results in an increase in the probability that remote practice is allowed.

Table A3 reports results with NP prescriptive authority as the dependent variable. The results are consistent with earlier estimates. Table A4 reports results for PA prescriptive authority, and as before, political pressure has no statistically significant effect on the probability that PAs possess full prescriptive authority. Overall, the alternative specifications developed from the Baron (2001) model of interest groups demonstrate that the probability states adopt different licensing laws is sensitive to political pressure.

In addition to clarifying the effect of changes in professional group clout, I also test whether my results are sensitive to different proxies for voter preferences. In general, I find no evidence that any of my results are sensitive to the specific proxies chosen for voter preferences. However, I am not able to test all potential variables that may influence the decision of states to enact different licensing laws. As explained above, the licensing laws I focus on are primarily statutory. If the structure of regulatory agencies affects licensing laws (statutory or regulatory), omitting variables to control for these structures will bias the results toward zero. The bias is toward zero because political contributions should not affect regulatory agencies to the same extent as legislatures since their members either do not receive or receive substantially less in political contributions than legislators. This implies that my results may be understated.

I also do not observe the presence of physicians (or other healthcare providers) in the legislature or on legislative committees responsible for overseeing licensing boards. If elected physician-legislators wield increased power in the legislature, this may influence both occupational licensing decisions and political contributions. The direction of this influence is not obvious, however, so the direction of any bias introduced by omitting the presence of physicians

in the legislature is unclear. However, in 2007 (the most recent year of data available), only 3.6% of state legislators were listed as "medical" professionals (which includes physicians as well as other providers), suggesting direct physician influence in legislatures is minimal (National Council of State Legislatures 2007).

Throughout my analysis, I have tested the effect of political clout on legal outcomes for NPs and PAs. While increased political clout does affect legal outcomes, an increase in political clout can occur for several reasons. In Becker's (1983) original model, groups were homogeneous, so increased political spending was equivalent to an increase in the number of members of a group. However, groups are not homogenous in reality and increased clout may reflect, in addition to an increase in the number of group members, an increase in spending per member, an increase in a group's spending efficiency, better leadership of a group, increased involvement of group members, improved group cohesion, etc.

To test whether the clout of each professional group is related to the size of that group within each state, I regress the clout of each group on the proportion of a state's labor force employed as a member of that group and on the proportion of other groups.[28] In unreported specifications, I find no statistically significant evidence that an increase in the proportion of a state's labor force employed as a member of a given group increases that group's clout with or without the other groups' proportions included as covariates. These results demonstrate that the effects of changes in political clout are not driven by changes in the number of members of a given professional group.

[28] Data on the proportion of a state's labor force employed as a member of each group come from the Bureau of Labor Statistics Occupational Employment Statistics Program. I include nurses of all types in the nurse category and physicians of all types in the physician category. In the non-physician category, I include all professions which have a professional organization appearing at least once in the campaign contribution data.

IX. Conclusion

NPs and PAs will play an increasingly important role in the healthcare system as more patients enter the system in the wake of the ACA. However, state occupational licensing laws often prevent them from providing the full range of services they are qualified to provide or require that they be supervised by physicians. Previous work has highlighted some effects of NPs and PAs operating under different licensing laws, but no study has yet considered why these laws exist in the form they do.

My findings suggest that both political pressure by professional interest groups and voter preferences play a role in states' choices of occupational licensing laws. While the role of voter preferences is expected in a democratic society, the role of professional interest groups suggests that state governments may not regulate in the public interest. As per capita spending by physician groups increases, the probability that a state imposes more restrictive supervision requirements on NPs and PAs increases. This suggests that physicians use licensing laws as a means to insulate themselves from competition. Additionally, it suggests that the concerns of the FTC and the United States Court of Appeals for the Fourth Circuit that state regulatory agencies are acting to protect the interests of regulated professionals at the expense of the public may be well-founded.

The results presented here also highlight the role of professional groups in a changing landscape of healthcare workforce regulation. As new professional groups emerge, e.g. clinical pharmacist practitioners in North Carolina or dental therapists in Minnesota, it will become increasingly important to reevaluate current occupational licensing laws in order to efficiently deploy healthcare professionals to meet the increased demand for healthcare. Understanding the role of professional group political pressure—both by existing groups seeking to maintain their

market power and by new groups seeking to compete—will allow state policymakers to make more informed choices on occupational licensing laws.

References

Avraham, Ronen. 2011. ‘‘Database of State Tort Law Reforms (DSTLR 4th),’’ Northwestern Law & Econ Research Paper No. 06-08; University of Texas Law, Law and Econ Research Paper No. 184. Available at SSRN: http://ssrn.com/abstrac1/4902711.

Avraham, Ronen, and Max Schanzenbach. 2010. "The Impact of Tort Reform on Private Health Insurance Coverage," 10 *American Law and Economics Review* 319-355.

Auerbach, David. 2012. "Will the NP Workforce Grow in the Future?: New Forecasts and Implications for Healthcare Delivery." 50 *Medical Care* 606-610.

Baron, David P. 2001. "Theories of Strategic Nonmarket Participation: Majority-Rule and Executive Institutions." 10 *Journal of Economic and Management Strategy* 47-89.

Becker, Gary S. 1983. "A Theory of Competition among Pressure Groups for Political Influence." 98 *Quarterly Journal of Economics* 371–400.

Bentley, Arthur 1908. *The Process of Government*. Chicago, Illinois. University of Chicago Press.

Bernheim, B. Douglas and Michael D. Whinston. 1986. "Menu Auctions, Resource Allocation, and Economic Influence." 101 *Quarterly Journal of Economics* 1–31.

Black, Duncan. 1948. "On the Rationale of Group Decision-Making." 56 *Journal of Political Economy* 23–34.

Brown, Sharon and Deanna Grimes. 1995. "A Meta-analysis of Nurse Practitioners and Nurse Midwives in Primary Care." 44 *Nursing Research* 332-339.

Buchanan, James and Gordon Tullock. 1962. *The Calculus of Consent*. Ann Arbor, Michigan. University of Michigan Press.

Chamberlain, Gary. 1980. "Analysis of Covariance with Qualitative Data." 47 *Review of Economic Studies* 225-238.

De Figueiredo, Rui J. and Geoff Edwards. 2007. "Does Private Money Buy Public Policy? Campaign Contributions and Regulatory Outcomes in Telecommunications." 16 *Journal of Economics and Management Strategy* 547-576.

Denzau, Arthur T. and Michael C. Munger. 1987. "Legislators and Interest Groups: How Unorganized Interests get Represented." 80 *American Political Science Review* 89-106.

Downs, Anthony. 1957. *An Economic Theory of Democracy*. New York, New York. Harper and Row.

Dueker, Michael J., Ada K. Jacox, David E. Kalist, and Stephen J. Spurr. 2005. "The Practice Boundaries of Advanced Practice Nurses: An Economic and Legal Analysis," 27 *Journal of Regulatory Economics* 309–329.

Feldstein, Paul. 2011. *Health Care Economics*. Albany, New York, Delmar Publishers.

Gilman, Daniel J. and Tara Isa Koslov. 2014. "Policy Perspectives: Competition and the Regulation of Advanced Practice Nurses." Federal Trade Commission Report.

Grossman, Gene M. and Elhanan Helpman. 1994. "Protection for Sale." 84 *American Economic Review* 833-850.

Hausman, Jerry A. and Paul A. Ruud. 1987. "Specifying and testing econometric models for rank ordered data." 34 *Journal of Econometrics* 83-104.

Hersch, Joni, Alison F. Del Rossi, and W. Kip Viscusi. 2004. "Voter Preferences and State Regulation of Smoking," 42 *Economic Inquiry* 455–468.

Hinnich, Melvin, and Michael Munger. 1997. *Analytical Politics*. New York, New York, Cambridge University Press.

Institute of Medicine. 2011. *The Future of Nursing: Leading Change, Advancing Health*. Washington, DC: The National Academies Press.

Kleiner, Morris M., Allison Marier, Kyoung Won Park, and Coady Wing. 2014. "Relaxing Occupational Licensing Requirements: Analyzing Wages and Prices for a Medical Service," Working paper.

Kuo, Yong-Fang, Figaro Loresto, Jr., Linda Rounds, and James Goodwin. 2013. "States With the Least Restrictive Regulations Experienced the Largest Increase in Patients Seen by Nurse Practitioners," 32 *Health Affairs* 1236-1243.

Laurant, Miranda, Mirjam Harmsen, Hub Wollersheim, Richard Grol, Marjan Faber, and Bonnie Sibbald. 2009. "The Impact of Non-physician clinicians: do they improve the quality and cost effectiveness of health care services." 66 *Medical Care Research and Review* 36s-55s.

Leland, Hayne. 1979. "Quality, Lemons, and Licensing: A Theory of Minimum Quality Standards," 87 *Journal of Political Economy* 1328-1346.

Letz, Elizabeth R., Mary O. Mundinger, Robert L. Kane, Sarah C. Hopkins, and Susan X. Lin. 2004. "Primary Care Outcomes in Patients Treated by Nurse Practitioners or Physicians: Two-Year Follow UP." 61 *Medical Care Research* 332-351.

Meehan, Brian, and Bruce Benson. 2015. "The occupations of regulators influence occupational regulation: evidence from the US private security industry," 162 *Public Choice* 97-117.

Mundinger, Mary O., Robert L Kane, Elizabeth R. Lenz, Annette M. Totten, Wei-Yann Tsai, Paul D. Cleary, William T. Friedwall, Albert L Siu, and Michael L Shelanski. 2000. "Primary Care Outcomes in Patients Treated by Nurse Practitioners or Physicians." 283 *Journal of the American Medical Association* 59-68.

National Council of State Legislatures. 2007. "Legislators' Occupations in All States," available at: http://www.ncsl.org/research/about-state-legislatures/legislator-occupations-national-data.aspx.

National Governors Association. 2012. "The Role of Nurse Practitioners in Meeting Increasing Demands for Primary Care." National Governors Association Paper.

National Governors Association. 2014. "The Role of Physician Assistants in Health Care Delivery." National Governors Association Paper.

Newhouse, Robin P., Julie Stanik-Hutt, Kathleen M. White, Meg Johantgen, Eric B. Bass, George Zangaro, Renee F. Wilson, Lily Fountain, Donald M. Steinwachs, Lou Heindel, and Jonathan P. Weiner. 2011. "Advanced Practice Nurse Outcomes1990-2008: A Systematic Review," 29 *Nursing Economics* 230-250.

Neyman, J., and Elizabeth L. Scott. 1948. "Consistent Estimates Based on Partially Consistent Observations" 16 *Econometrica* 1-32.

Niskanen, William 1971. *Bureaucracy and Representative Government*. Chicago, Illinois. Aldine-Atherton.

Olson, Mancur. 1982. *The Rise and Decline of Nations*. New Haven, Connecticut. Yale University Press.

Peltzman, Sam. 1976. Toward a More General Theory of Regulation. 19 *Journal of Law and Economics* 211-240.

Perry, John J. 2009. "The Rise and Impact of Nurse Practitioners and Physician Assistants on Their Own and Cross-Occupation Incomes," 27 *Contemporary Economic Policy* 491–511

Persico, Nicola. 2014. "The Political Economy of Occupational Licensing Associations," *Journal of Law, Economics, & Organization*, forthcoming.

Posner, Richard. 1971. "Taxation by Regulation." 2 *Bell Journal of Economics and Management Science* 22-50.

Spetz, Joanne, Stephen T. Parente, Robert J. Town, and Dawn Bazarko. 2013. "Scope-Of-Practice Laws for Nurse Practitioners Limit Cost Savings that can be Achieved in Retail Clinics," 32 *Health Affairs* 1977-1984.

Stange, Kevin. 2014. "How Does Provider Supply and Regulation Influence Health Care Markets? Evidence from Nurse Practitioners and Physician Assistants," 33 *Journal of Health Economics* 1-27.

Stearns, Maxwell L., and Todd J. Zywicki. 2009. *Public Choice Concepts and Applications in Law*. West.

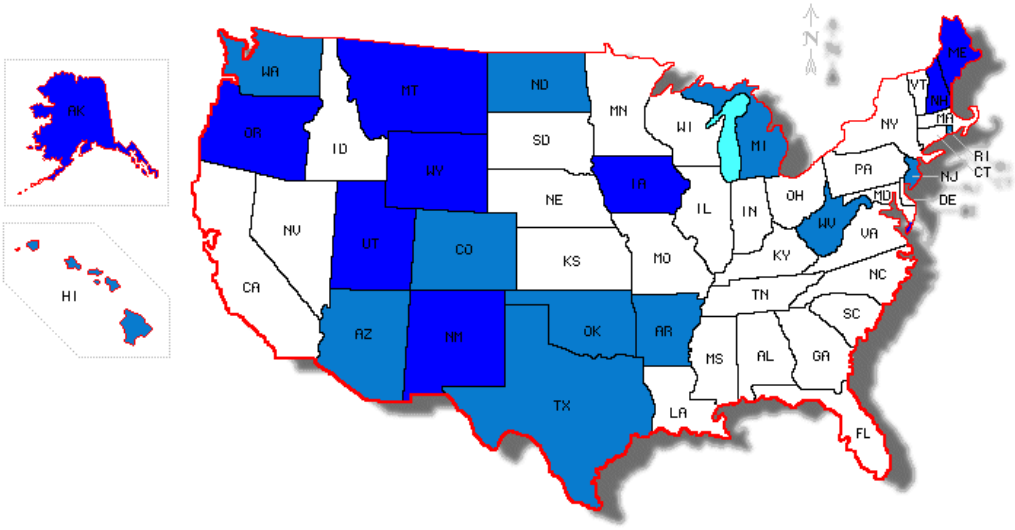
Stigler, George. 1971. "The Theory of Economic Regulation," 2 *Bell Journal of Economics and Management Science* 3-21.

Traczynski, Jeffrey and Victoria Udalova. 2014. "Nurse Practitioner Independence, Health Care Utilization, and Health Outcomes." Working Paper.

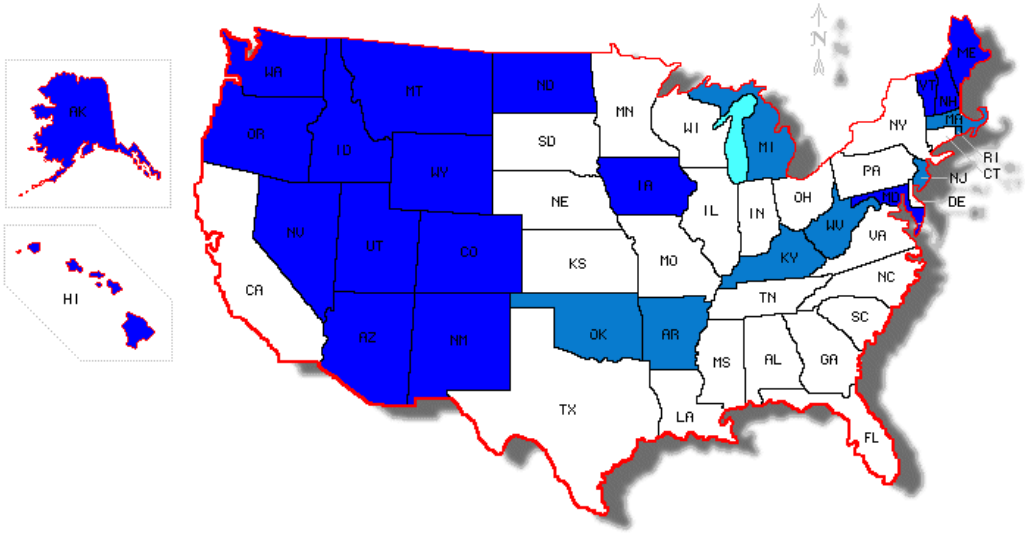
Tables and Figures

Figure 1: NP Supervision Laws

1999



2013

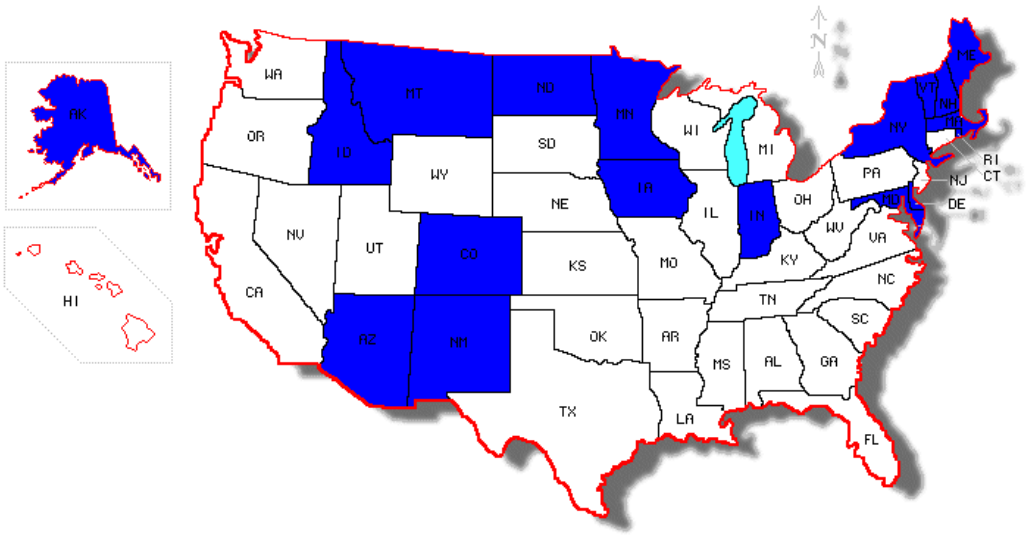


NP Independence

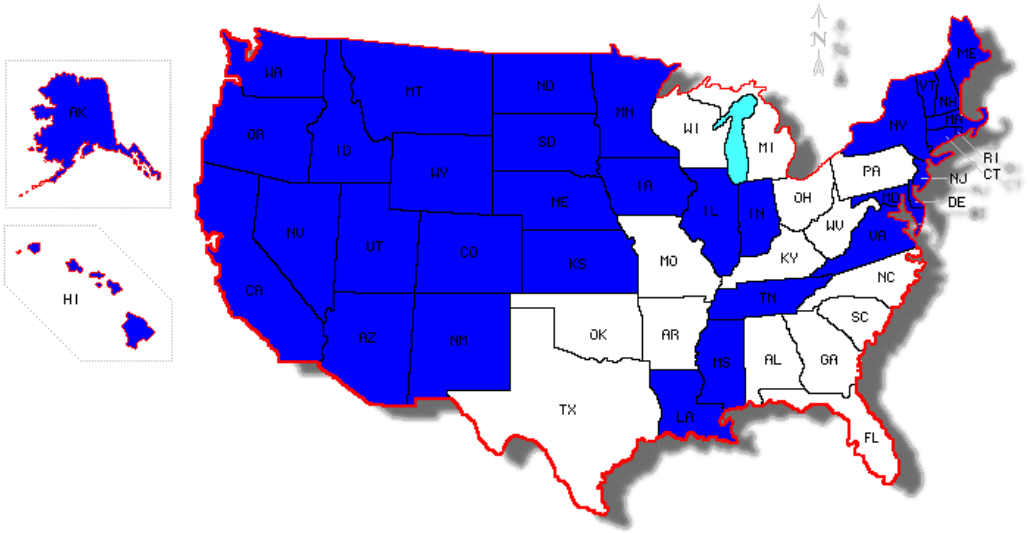
Prescription Supervision

Figure 2: NP Prescription Authority

1999



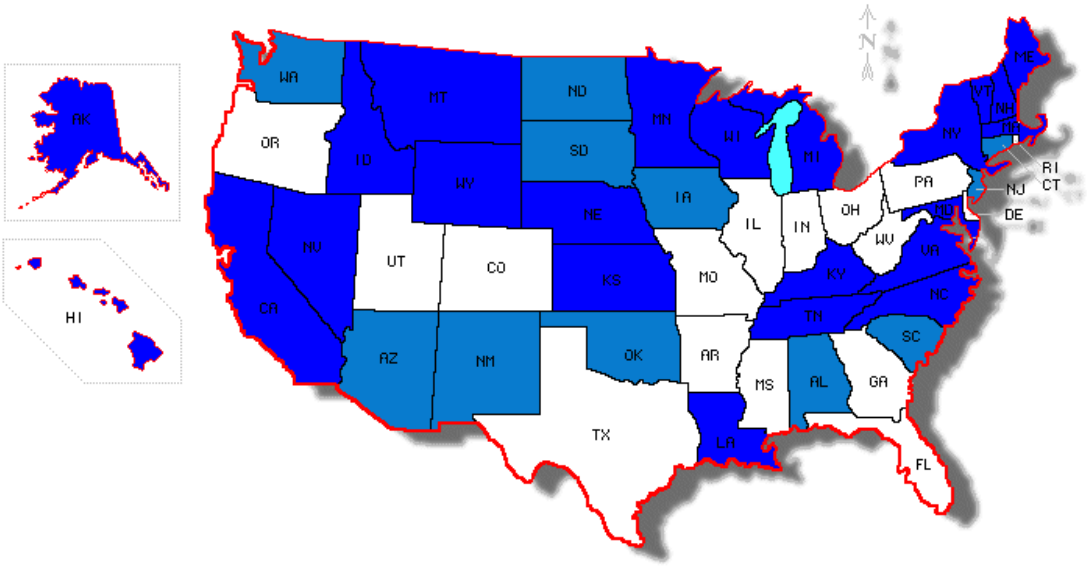
2013



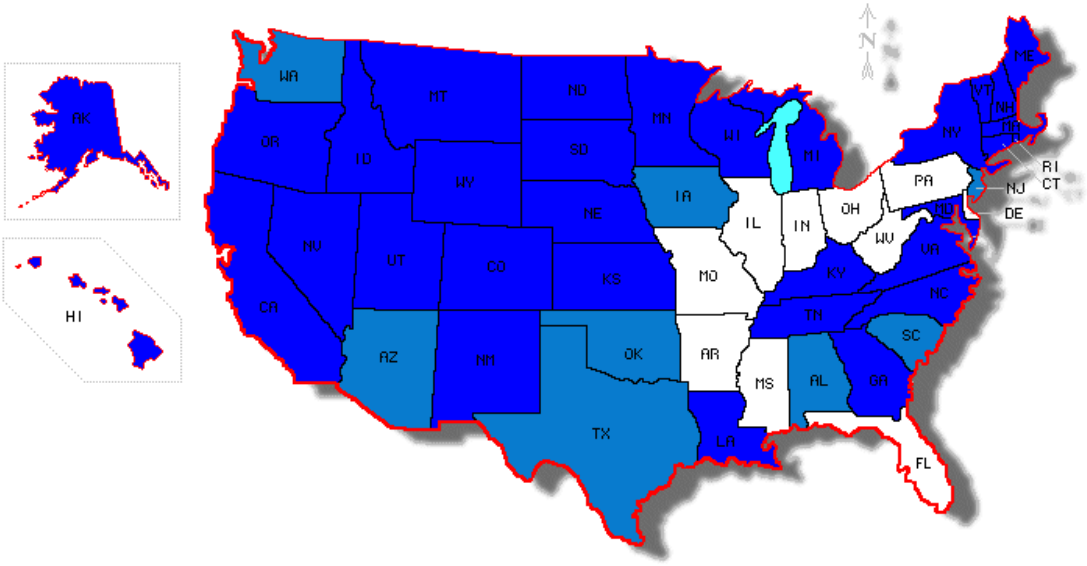
Full Prescriptive Authority

Figure 3: PA Supervision Laws

1999



2013

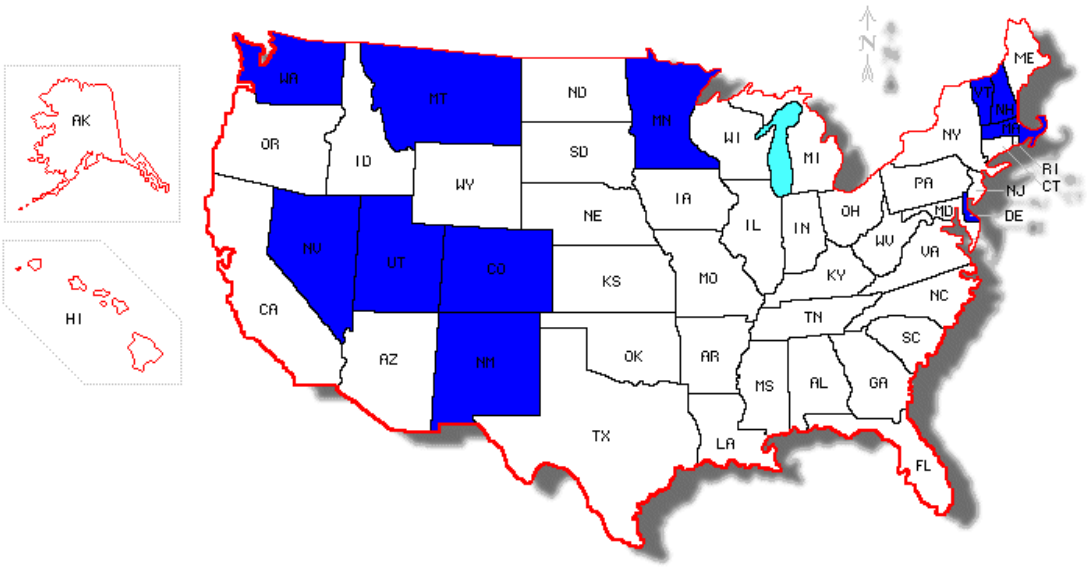


Remote Practice

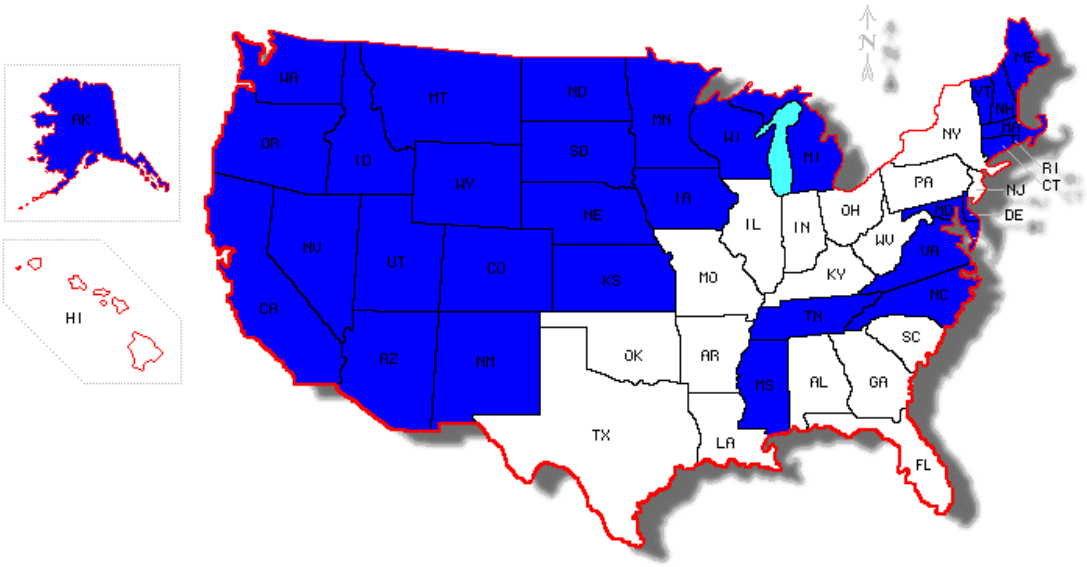
Quasi-remote Practice

Figure 4: PA Prescription Authority

1999



2013



Full Prescriptive Authority

Table 1: Licensing Laws from 1998 through 2013

Panel A: NP Supervision Laws

Always Independence	Always Prescription Supervision	Always Complete Supervision
AK, DC, IA, ME, MT, NH, NM, OR, UT	AR, MI, NJ, OK, RI, WV	AL, CA, CT, FL, GA, IL, IN, LA, MN, MS, MO, NE, NV, NY, NC, OH, PA, SC, SD, TX, VT, VA, WI, WY
Change from Complete to Prescription Supervision	**Change from Complete Supervision to Independence**	**Change from Prescription Supervision to Independence**
KY (2001), MA (2012), MD (2011) TX (2002)*	ID (2005), VT (2011)	AZ (2000), CO (2010), HI (2010), MD (2012), ND (2011), WA (2001)

Panel B: NP Prescription Authority

Always Full Prescription Authority	Always Restricted Prescription Authority
AK, AZ, CO, DE, DC, IN, IA, ME, MD, MA, MN, MT, NH, NM, NY, ND, RI, VT	AL, AR, FL, GA, KY, MO, NC, OH, OK, PA, SC, TX, WV, WI
Change from Restricted to Full Prescription Authority	
CA (2005), CT (2000), HI (2006), ID (1999), IL (2013), KS (2002), LA (2006), MI (2000), MS (2003), NE (2007), NV (2003), NJ (2005), OR (2001), SD (2007), TN (2000), UT (2000), VA (2007), WA (2009), WY (2002)	

Panel C: PA Supervision Laws

Always Remote Practice	Always Quasi-Remote Practice	Always Onsite Supervision
AK, CA, HI, KS, KY, ME, MD, MA, MI, MN, MT, NE, NH, NY, NC, TN, VA, WI, WY	AL, AZ, IA, NJ, OK, WA,	AR, DE, FL, GA, IL, IN, MS, OH, PA, SC, WV,
Change from Onsite to Quasi-remote	**Change from Onsite to Remote**	**Change from Quasi-remote to Remote**
MO (2010), OR (2002), TX (2003)	CO (2006), DC (2008), ID (1999), RI (2002), UT (2002)	CT (2008), NV (1999), NM (2006), ND (2003), OR (2010), SD (2008)

Panel D: PA Prescription Authority

Always Full Prescription Authority	Always Restricted Prescription Authority
DE, MA, MN, MT, NV, NH, NM, UT, VT, WA,	AL, AR, FL, GA, HI, IL, IN, KY, LA, MO, NJ, NY, OH, OK, PA, SC, TX, WV,
Change from Restricted to Full Prescription Authority	
AK (2002), AZ (2012), CA (2008), CT (2001), DC (2008), ID (2002), IA (2009), KS (2002), ME (2006), MD (2000), MI (2012), MS (2006), NE (2006), NC (2000), ND (2010), OR (2006), RI (2000), SD (2008), TN (2002), VA (2008), WI (2000), WY (2003)	

Note: All reported years reflect the first year a state is coded as having the new law. These years do not necessarily reflect the year that the state passed the relevant law for several reasons. See the text for further discussion.
*Texas amended its law to move from prescription supervision to complete supervision in 2002.

Table 2: Summary Statistics

Variables	Mean	Std. dev.
Political Pressure		
Physician clout	26.310	48.240
Nurse clout	1.286	2.473
Non-physician clout	1.380	2.091
Hospital clout	28.980	49.530
Voter Preferences		
Percentage private insurance	69.900	6.759
Percentage Medicaid	13.160	4.137
Percentage Medicare	14.530	2.390
Democratic governor	0.465	0.495
Log(income)	10.430	0.216
Population density	0.370	1.319
Percentage black	10.6	11.0
Other Regulation		
Noneconomic damages cap	0.366	0.482
Collateral source rule reform	0.644	0.479
Joint and several reform	0.745	0.436

Note: All clout variables are defined as the amount of political spending by the relevant group per 1,000 state residents. All spending has been adjusted to 2013 dollars.

Table 3: Linear Probability Model Estimates for NP Independence

Variables	(1)	(2)	(3)
Political Pressure			
Log(Nurse clout) (2-year)	0.006*		
	(0.064)		
Log(Physician clout) (2-year)	-0.025		
	(0.422)		
Log(Hospital clout) (2-year)	0.014		
	(0.665)		
Log(Nurse clout) (3-year)		0.010***	
		(0.006)	
Log(Physician clout) (3-year)		-0.047	
		(0.214)	
Log(Hospital clout) (3-year)		0.030	
		(0.448)	
Log(Nurse clout) (4-year)			0.011***
			(0.002)
Log(Physician clout) (4-year)			-0.095***
			(0.001)
Log(Hospital clout) (4-year)			0.077***
			(0.007)
Voter Preferences			
Percentage private insurance	0.014***	0.014***	0.013***
	(0.001)	(0.001)	(0.001)
Percentage Medicaid	0.012**	0.011**	0.012**
	(0.023)	(0.024)	(0.011)
Percentage Medicare	0.014*	0.014**	0.015**
	(0.053)	(0.048)	(0.033)
Democratic governor	0.056***	0.054***	0.055***
	(0.001)	(0.001)	(0.001)
Log(income)	0.257	0.212	0.151
	(0.478)	(0.551)	(0.648)
Population density	-0.001	0.043	0.078
	(0.987)	(0.545)	(0.247)
Percentage black	0.015**	0.015**	0.013*
	(0.024)	(0.033)	(0.054)
Other Regulation			

Noneconomic damages cap	0.098***	0.100***	0.106***
	(0.002)	(0.001)	(0.001)
Collateral source rule reform	-0.133***	-0.136***	-0.139***
	(0.001)	(0.001)	(0.001)
Joint and several reform	-0.024	-0.023	-0.026
	(0.392)	(0.393)	(0.318)
State fixed effects	yes	yes	yes
Year fixed effects	yes	yes	yes
Observations	765	765	765
R-squared	0.891	0.893	0.896

Note: The dependent variable in all specifications is an indicator for whether a state allowed independent NP practice in a given year. All specifications include state and year fixed effects. Robust p-values are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table 4: Linear Probability Model Estimates for Physician Supervision of NP Prescribing

Variables	(1)	(2)	(3)
Political Pressure			
Log(Nurse clout) (2-year)	0.004		
	(0.334)		
Log(Physician clout) (2-year)	0.002		
	(0.924)		
Log(Hospital clout) (2-year)	-0.014		
	(0.556)		
Log(Nurse clout) (3-year)		0.010**	
		(0.012)	
Log(Physician clout) (3-year)		0.006	
		(0.844)	
Log(Hospital clout) (3-year)		-0.024	
		(0.410)	
Log(Nurse clout) (4-year)			0.013***
			(0.006)
Log(Physician clout) (4-year)			0.016
			(0.509)
Log(Hospital clout) (4-year)			-0.035
			(0.160)
Voter Preferences			
Percentage private insurance	0.007	0.007*	0.007*
	(0.104)	(0.099)	(0.090)
Percentage Medicaid	0.009	0.008	0.008
	(0.224)	(0.253)	(0.239)
Percentage Medicare	0.010*	0.011*	0.011*
	(0.080)	(0.078)	(0.067)
Democratic governor	-0.005	-0.007	-0.008
	(0.687)	(0.557)	(0.523)
Log(income)	0.221*	0.207	0.186
	(0.098)	(0.120)	(0.155)
Population density	1.599	1.866*	1.969*
	(0.120)	(0.074)	(0.062)
Percentage black	0.001	0.001	0.001
	(0.885)	(0.890)	(0.881)
Other Regulation			
Noneconomic damages cap	-0.128**	-0.132**	-0.134***
	(0.013)	(0.011)	(0.010)

Collateral source rule reform	0.066	0.067	0.069
	(0.138)	(0.136)	(0.125)
Joint and several reform	0.070**	0.069**	0.069**
	(0.019)	(0.018)	(0.018)
State fixed effects	yes	yes	yes
Year fixed effects	yes	yes	yes
Observations	480	480	480
R-squared	0.931	0.932	0.932

Note: The dependent variable in all specifications is an indicator for whether a state required physician supervision of only NP prescribing in a given year. All specifications include state and year fixed effects. Robust p-values are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table 5: Rank ordered Logit Results for NP Supervision laws

Variables	(1)	(2)	(3)
Political Pressure			
Log(Nurse clout) (2-year)	0.00328		
	(0.768)		
Log(Physician clout) (2-year)	-0.0370		
	(0.434)		
Log(Hospital clout) (2-year)	0.00349		
	(0.946)		
Log(Nurse clout) (3-year)		0.0178	
		(0.272)	
Log(Physician clout) (3-year)		-0.0798*	
		(0.0648)	
Log(Hospital clout) (3-year)		0.00979	
		(0.861)	
Log(Nurse clout) (4-year)			0.0192
			(0.324)
Log(Physician clout) (4-year)			-0.311***
			(1.44e-10)
Log(Hospital clout) (4-year)			0.234***
			(0.000152)
Voter Preferences			
Percentage private insurance	0.0638***	0.0615***	0.0563***
	(0.00358)	(0.00378)	(0.00688)
Percentage Medicaid	0.0673**	0.0625**	0.0628**
	(0.0223)	(0.0379)	(0.0381)
Percentage Medicare	0.0413	0.0400	0.0421
	(0.274)	(0.287)	(0.272)
Democratic governor	0.212**	0.213**	0.207*
	(0.0452)	(0.0483)	(0.0553)
Log(income)	-0.0709	-0.0603	-0.276
	(0.971)	(0.973)	(0.851)
Population density	-0.00630	0.0849	0.168
	(0.984)	(0.790)	(0.611)
Percentage black	0.0660	0.0606	0.0461
	(0.130)	(0.153)	(0.285)
Year indicators	yes	yes	yes
Observations	765	765	765
Number of groups	51	51	51

Note: The dependent variable in all specifications is a ranking of NP supervision laws from least restrictive to most restrictive. All specifications include state and year fixed effects. Robust p-values are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table 6: Linear Probability Model Estimates for PA Remote Practice

Variables	(1)	(2)	(3)
Political Pressure			
Log(Non-physician clout) (2-year)	-0.006		
	(0.188)		
Log(Physician clout) (2-year)	-0.048**		
	(0.019)		
Log(Hospital clout) (2-year)	0.050**		
	(0.034)		
Log(Non-physician clout) (3-year)		-0.009*	
		(0.098)	
Log(Physician clout) (3-year)		-0.048**	
		(0.033)	
Log(Hospital clout) (3-year)		0.055**	
		(0.047)	
Log(Non-physician clout) (4-year)			-0.011*
			(0.059)
Log(Physician clout) (4-year)			-0.047*
			(0.075)
Log(Hospital clout) (4-year)			0.058*
			(0.073)
Voter Preferences			
Fraction private insurance	-0.001	0.001	0.001
	(0.975)	(0.945)	(0.899)
Percentage Medicaid	-0.003	-0.003	-0.003
	(0.539)	(0.555)	(0.553)
Percentage Medicare	-0.024***	-0.024***	-0.023***
	(0.002)	(0.002)	(0.003)
Log(income)	0.320	0.290	0.299
	(0.191)	(0.234)	(0.229)
Democratic governor	0.033**	0.033**	0.034**
	(0.021)	(0.019)	(0.017)
Fraction black	0.007	0.008	0.008
	(0.432)	(0.390)	(0.380)
Population density	0.684***	0.683***	0.665***
	(0.001)	(0.001)	(0.001)
Other Regulation			

Noneconomic damages cap	-0.096***	-0.098***	-0.100***
	(0.001)	(0.001)	(0.001)
Collateral source rule reform	-0.072***	-0.070***	-0.067***
	(0.001)	(0.002)	(0.004)
Joint and several reform	-0.018	-0.021	-0.023
	(0.433)	(0.385)	(0.360)
State fixed effects	yes	yes	yes
Year fixed effects	yes	yes	yes
Observations	765	765	765
R-squared	0.877	0.877	0.877

Note: The dependent variable in all specifications is an indicator for whether a state allowed PAs to practice remotely. All specifications include state and year fixed effects. Robust p-values are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table 7: Linear Probability Model Estimates for PA Quasi-remote Practice

Variables	(1)	(2)	(3)
Political Pressure			
Log(Non-physician clout) (2-year)	-0.005		
	(0.219)		
Log(Physician clout) (2-year)	-0.049***		
	(0.009)		
Log(Hospital clout) (2-year)	0.058***		
	(0.009)		
Log(Non-physician clout) (3-year)		-0.006	
		(0.264)	
Log(Physician clout) (3-year)		-0.049***	
		(0.009)	
Log(Hospital clout) (3-year)		0.060**	
		(0.011)	
Log(Non-physician clout) (4-year)			-0.009
			(0.207)
Log(Physician clout) (4-year)			-0.051**
			(0.014)
Log(Hospital clout) (4-year)			0.064**
			(0.016)
Voter Preferences			
Percentage private insurance	-0.006	-0.006	-0.006
	(0.344)	(0.352)	(0.371)
Percentage Medicaid	-0.014	-0.014	-0.014
	(0.172)	(0.165)	(0.172)
Percentage Medicare	0.003	0.004	0.003
	(0.755)	(0.712)	(0.752)
Democratic governor	0.056**	0.056**	0.057**
	(0.014)	(0.014)	(0.013)
Log(income)	-0.911**	-0.936**	-0.943**
	(0.012)	(0.011)	(0.012)
Population density	-3.586***	-3.556***	-3.509***
	(0.002)	(0.003)	(0.003)
Percentage black	-0.029**	-0.029**	-0.029**
	(0.031)	(0.035)	(0.037)
Other Regulation			
Noneconomic damages cap	0.187**	0.185**	0.185**
	(0.014)	(0.014)	(0.014)

Collateral source rule reform	-0.194***	-0.192***	-0.191***
	(0.002)	(0.002)	(0.002)
Joint and several reform	-0.160***	-0.160***	-0.158***
	(0.002)	(0.002)	(0.002)
State fixed effects	yes	yes	yes
Year fixed effects	yes	yes	yes
Observations	270	270	270
R-squared	0.928	0.928	0.928

Note: The dependent variable in all specifications is an indicator for whether a state allowed PAs to practice quasi-remotely (i.e., with some periodic onsite physician supervision) in a given year. All specifications include state and year fixed effects. Robust p-values are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table 8: Rank ordered Logit Results for PA Supervision laws

Variables	(1)	(2)	(3)
Political Pressure			
Log(Non-physician clout) (2-year)	-0.0227		
	(0.155)		
Log(Physician clout) (2-year)	-0.132***		
	(4.80e-07)		
Log(Hospital clout) (2-year)	0.152***		
	(0.000288)		
Log(Non-physician clout) (3-year)		-0.0313	
		(0.118)	
Log(Physician clout) (3-year)		-0.125***	
		(4.20e-05)	
Log(Hospital clout) (3-year)		0.171***	
		(0.00502)	
Log(Non-physician clout) (4-year)			-0.0348
			(0.176)
Log(Physician clout) (4-year)			-0.130***
			(0.00149)
Log(Hospital clout) (4-year)			0.191**
			(0.0107)
Voter Preferences			
Percentage private insurance	-0.0181	-0.0164	-0.0164
	(0.199)	(0.243)	(0.231)
Percentage Medicaid	-0.0224	-0.0212	-0.0205
	(0.216)	(0.238)	(0.257)
Percentage Medicare	-0.0475	-0.0462	-0.0426
	(0.104)	(0.109)	(0.135)
Democratic governor	0.0849	0.0889	0.0922
	(0.163)	(0.142)	(0.131)
Log(income)	0.332	0.222	0.217
	(0.769)	(0.847)	(0.851)
Population density	2.526***	2.517***	2.492***
	(0)	(0)	(0)
Percentage black	0.00691	0.00336	0.00369
	(0.858)	(0.931)	(0.925)
Year indicators	yes	yes	yes
Observations	765	765	765
Number of groups	51	51	51

Note: The dependent variable in all specifications is a ranking of PA supervision laws from least restrictive to most restrictive. All specifications include state and year fixed effects. Robust p-values are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table 9: Linear Probability Model Estimates for NP Controlled Substance Authority

Variables	(1)	(2)	(3)
Political Pressure			
Log(Nurse clout) (2-year)	-0.012***		
	(0.008)		
Log(Physician clout) (2-year)	0.055***		
	(0.002)		
Log(Hospital clout) (2-year)	-0.058***		
	(0.003)		
Log(Nurse clout) (3-year)		-0.012**	
		(0.023)	
Log(Physician clout) (3-year)		0.065***	
		(0.001)	
Log(Hospital clout) (3-year)		-0.069***	
		(0.003)	
Log(Nurse clout) (4-year)			-0.010*
			(0.078)
Log(Physician clout) (4-year)			0.086***
			(0.004)
Log(Hospital clout) (4-year)			-0.087***
			(0.008)
Voter Preferences			
Percentage private insurance	-0.006	-0.006	-0.006
	(0.298)	(0.262)	(0.290)
Percentage Medicaid	-0.009	-0.010*	-0.011*
	(0.113)	(0.096)	(0.066)
Percentage Medicare	0.001	0.001	0.001
	(0.884)	(0.932)	(0.987)
Democratic governor	-0.031**	-0.032**	-0.033**
	(0.023)	(0.020)	(0.015)
Log(income)	-0.331	-0.277	-0.199
	(0.323)	(0.399)	(0.513)
Population density	0.054	0.049	0.028
	(0.445)	(0.474)	(0.653)
Percentage black	-0.0213	-0.0216	-0.000
	(0.773)	(0.827)	(0.972)
Other Regulation			

Noneconomic damages cap	-0.045	-0.048	-0.049
	(0.350)	(0.323)	(0.311)
Collateral source rule reform	-0.234***	-0.224***	-0.219***
	(0.001)	(0.001)	(0.001)
Joint and several reform	0.130*	0.130*	0.127*
	(0.053)	(0.052)	(0.057)
State fixed effects	yes	yes	yes
Year fixed effects	yes	yes	yes
Observations	765	765	765
R-squared	0.860	0.861	0.864

Note: The dependent variable in all specifications is an indicator for whether a state granted essentially the same prescriptive authority to NPs as physicians in a given year. All specifications include state and year fixed effects. Robust p-values are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table 10: Linear Probability Model Estimates for PA Controlled Substance Authority

Variables	(1)	(2)	(3)
Political Pressure			
Log(Non-physician clout) (2-year)	0.005		
	(0.342)		
Log(Physician clout) (2-year)	-0.009		
	(0.807)		
Log(Hospital clout) (2-year)	0.008		
	(0.828)		
Log(Non-physician clout) (3-year)		0.004	
		(0.580)	
Log(Physician clout) (3-year)		-0.046	
		(0.145)	
Log(Hospital clout) (3-year)		0.054	
		(0.125)	
Log(Non-physician clout) (4-year)			0.003
			(0.675)
Log(Physician clout) (4-year)			-0.052
			(0.168)
Log(Hospital clout) (4-year)			0.063
			(0.122)
Voter Preferences			
Percentage private insurance	-0.001	-0.001	-0.001
	(0.869)	(0.864)	(0.878)
Percentage Medicaid	-0.016**	-0.015**	-0.015**
	(0.024)	(0.036)	(0.040)
Percentage Medicare	-0.008	-0.008	-0.008
	(0.461)	(0.466)	(0.460)
Log(income)	1.162***	1.042***	1.025***
	(0.001)	(0.002)	(0.002)
Democratic governor	-0.039*	-0.038*	-0.037*
	(0.064)	(0.074)	(0.078)
Percentage black	-0.005	-0.006	-0.006
	(0.651)	(0.600)	(0.603)
Population density	0.373***	0.408***	0.412***
	(0.001)	(0.001)	(0.001)
Other Regulation			

Noneconomic damages cap	0.032	0.040	0.040
	(0.523)	(0.427)	(0.426)
Collateral source rule reform	-0.233***	-0.236***	-0.238***
	(0.001)	(0.001)	(0.001)
Joint and several reform	-0.126***	-0.134***	-0.136***
	(0.008)	(0.006)	(0.006)
State fixed effects	yes	yes	yes
Year fixed effects	yes	yes	yes
Observations	765	765	765
R-squared	0.790	0.791	0.791

Note: The dependent variable in all specifications is an indicator for whether a state granted essentially the same prescriptive authority to PAs as physicians in a given year. All specifications include state and year fixed effects. Robust p-values are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

Appendix A

Table A1: Linear Probability Model Estimates for NP Supervision Laws

Variables	(1)	(2)	(3)
Political Pressure			
Nurse proportion (2-year)	0.319**		
	(0.011)		
Nurse proportion (3-year)		0.442***	
		(0.003)	
Nurse proportion (4-year)			0.552***
			(0.003)
Voter Preferences			
Percentage private insurance	0.015***	0.015***	0.015***
	(0.001)	(0.001)	(0.001)
Percentage Medicaid	0.012**	0.013**	0.013**
	(0.015)	(0.014)	(0.011)
Percentage Medicare	0.014*	0.014**	0.015**
	(0.057)	(0.046)	(0.043)
Democratic governor	0.056***	0.056***	0.057***
	(0.001)	(0.001)	(0.001)
Log(income)	0.250	0.224	0.211
	(0.464)	(0.507)	(0.523)
Percentage Black	0.016**	0.016**	0.014**
	(0.016)	(0.020)	(0.032)
Population density	0.019	0.047	0.055
	(0.772)	(0.463)	(0.358)
Other Regulation			
Noneconomic damages cap	0.100***	0.101***	0.103***
	(0.001)	(0.001)	(0.001)
Collateral source rule reform	-0.129***	-0.134***	-0.136***
	(0.001)	(0.001)	(0.001)
Joint and several reform	-0.025	-0.024	-0.024
State fixed effects	yes	yes	yes
Year fixed effects	yes	yes	yes
Observations	765	765	765
R-squared	0.890	0.891	0.891

Note: The dependent variable in all specifications is an indicator for whether a state allowed independent NP practice. All specifications include state and year fixed effects. Robust p-values are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table A2: Linear Probability Model Estimates for PA Supervision Laws

Variables	(1)	(2)	(3)
Political Pressure			
Non-physician proportion (2-year)	0.506**		
	(0.016)		
Non-physician proportion (3-year)		0.542**	
		(0.020)	
Non-physician proportion (4-year)			0.561**
			(0.025)
Voter Preferences			
Percentage private insurance	0.001	0.001	0.001
	(0.897)	(0.878)	(0.857)
Percentage Medicaid	-0.003	-0.003	-0.003
	(0.533)	(0.537)	(0.552)
Percentage Medicare	-0.023***	-0.022***	-0.022***
	(0.004)	(0.005)	(0.004)
Log(income)	0.345	0.320	0.326
	(0.150)	(0.182)	(0.180)
Democratic governor	0.031**	0.031**	0.032**
	(0.030)	(0.030)	(0.028)
Percentage black	0.007	0.006	0.006
	(0.409)	(0.462)	(0.497)
Population density	0.750***	0.751***	0.743***
	(0.001)	(0.001)	(0.001)
Other Regulation			
Noneconomic damages cap	-0.095***	-0.095***	-0.095***
	(0.000)	(0.000)	(0.000)
Collateral source rule reform	-0.062***	-0.070***	-0.072***
	(0.008)	(0.002)	(0.001)
Joint and several reform	-0.015	-0.012	-0.011
	(0.541)	(0.629)	(0.651)
State fixed effects	yes	yes	yes
Year fixed effects	yes	yes	yes
Observations	765	765	765
R-squared	0.877	0.877	0.877

Note: The dependent variable in all specifications is an indicator for whether a state allowed remote PA practice. All specifications include state and year fixed effects. Robust p-values are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table A3: Linear Probability Model Estimates for NP Controlled Substances Authority

Variables	(1)	(2)	(3)
Political Pressure			
Nurse proportion (2-year)	-0.470**		
	(0.035)		
Nurse proportion (3-year)		-0.535**	
		(0.042)	
Nurse proportion (4-year)			-0.715**
			(0.011)
Voter Preferences			
Percentage private insurance	-0.006	-0.006	-0.006
	(0.260)	(0.251)	(0.234)
Percentage Medicaid	-0.011*	-0.011*	-0.011*
	(0.071)	(0.068)	(0.054)
Percentage Medicare	0.002	0.001	0.001
	(0.854)	(0.917)	(0.933)
Log(income)	1.078***	1.098***	1.121***
	(0.001)	(0.001)	(0.001)
Democratic governor	-0.026	-0.026	-0.026
	(0.228)	(0.233)	(0.225)
Percentage black	-0.004	-0.003	-0.002
	(0.745)	(0.772)	(0.873)
Population density	-0.441***	-0.456***	-0.475***
	(0.001)	(0.001)	(0.001)
Other Regulation			
Noneconomic damages cap	-0.045	-0.045	-0.048
	(0.347)	(0.343)	(0.308)
Collateral source rule reform	-0.228***	-0.221***	-0.219***
	(0.001)	(0.001)	(0.001)
Joint and several reform	0.118*	0.116*	0.117*
	(0.084)	(0.086)	(0.079)
State fixed effects	yes	yes	yes
Year fixed effects	yes	yes	yes
Observations	765	765	765
R-squared	0.814	0.814	0.815

Note: The dependent variable in all specifications is an indicator for whether a state granted essentially the same prescriptive authority to NPs as physicians in a given year. All specifications include state and year fixed effects. Robust p-values are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table A4: Linear Probability Model Estimates for PA Controlled Substances Authority

Variables	(1)	(2)	(3)
Political Pressure			
Non-physician proportion (2-year)	0.147		
	(0.516)		
Non-physician proportion (3-year)		0.262	
		(0.337)	
Non-physician proportion (4-year)			0.396
			(0.231)
Voter Preferences			
Percentage private insurance	-0.001	-0.001	-0.001
	(0.864)	(0.861)	(0.865)
Percentage Medicaid	-0.016**	-0.016**	-0.015**
	(0.027)	(0.029)	(0.034)
Percentage Medicare	-0.009	-0.008	-0.008
	(0.439)	(0.460)	(0.468)
Log(income)	1.146***	1.117***	1.097***
	(0.001)	(0.001)	(0.001)
Democratic governor	-0.039*	-0.039*	-0.039*
	(0.065)	(0.066)	(0.069)
Percentage black	-0.005	-0.006	-0.006
	(0.644)	(0.617)	(0.580)
Population density	0.380***	0.399***	0.415***
	(0.001)	(0.001)	(0.001)
Other Regulation			
Noneconomic damages cap	0.032	0.035	0.037
	(0.515)	(0.489)	(0.459)
Collateral source rule reform	-0.233***	-0.235***	-0.237***
	(0.001)	(0.001)	(0.001)
Joint and several reform	-0.125***	-0.124***	-0.124***
	(0.008)	(0.008)	(0.008)
State fixed effects	yes	yes	yes
Year fixed effects	yes	yes	yes
Observations	765	765	765
R-squared	0.789	0.790	0.790

Note: The dependent variable in all specifications is an indicator for whether a state granted essentially the same prescriptive authority to PAs as physicians in a given year. All specifications include state and year fixed effects. Robust p-values are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

CHAPTER 2

BEYOND PHYSICIANS: THE EFFECT OF LICENSING AND LIABILITY LAWS ON NURSE PRACTITIONERS AND PHYSICIAN ASSISTANTS

I. Introduction

Following the passage of the Patient Protection and Affordable Care Act (ACA), millions of new patients have entered and continue to enter the healthcare system. Designed to increase access to care across the country, the ACA focused primarily on the demand side of healthcare by augmenting the ability of individuals to pay for healthcare.[29] One option for increasing the supply of healthcare is the increased use of nurse practitioners (NPs) and physician assistants (PAs) in the provision of healthcare. Members of both of these professions require advanced training in the provision of medical and healthcare services and provide many services historically offered only by physicians. In many areas, NPs and PAs are the principal providers of primary care services (Auerbach 2012). With over 135,000 NPs and 87,000 PAs licensed to practice in 2012, they already outnumber family and general practice physicians, and the growth rate of NPs in primary care is more than 8 times as large as the growth rate of physicians entering primary care (Stange 2014, Traczynski and Udalova 2014).

While NPs and PAs function similarly to physicians in a variety of healthcare settings, states regulate their practices differently than physicians. State occupational licensing laws determine what services different professions may provide and under what conditions they may provide them. Two types of occupational licensing laws are particularly important for NPs and

[29] The ACA did include several provisions designed to increase the supply of healthcare, such as increasing the number of primary care residencies for physicians.

PAs—physician supervision laws and scope of practice laws. Physician supervision laws determine to what extent a physician must supervise an NP or a PA. Scope of practice laws determine what services NPs and PAs may provide.

State occupational licensing laws can prevent unqualified or incompetent providers from supplying low-quality or harmful healthcare to patients; however, these laws may also decrease the availability and increase the price of healthcare if they restrain the ability of qualified professionals to provide care. The Institute of Medicine (IOM) and National Governors Association (NGA) have advised states that relaxing NP and PA occupational licensing laws can increase the supply of healthcare (IOM 2011; NGA 2012, 2014). In 2014, the Federal Trade Commission issued a report explaining that restrictions on the practices of NPs could harm competition in healthcare services markets, raise prices in these markets, and decrease access to healthcare (Gilman and Koslov 2014).

While occupational licensing laws play an important role in the practices of NPs and PAs, they are not the only legal regime that affects the practices of these healthcare providers. Just like physicians, dentists, lawyers, and other professionals, NPs and PAs are subject to state tort law and may be sued for malpractice. Malpractice liability can efficiently deter the provision of negligent care, but it may also have a chilling effect on healthcare providers. Tort reforms, which are statutory modifications of traditional tort law, generally reduce this chilling effect by lowering the expected costs of liability. The American Medical Association, among other organizations, asserts that physicians respond to rising liability costs by performing expensive and unnecessary procedures to avoid liability (defensive medicine), providing less care, retiring early, or relocating to states that have enacted tort reforms.

Previous research has found some evidence that tort reform increases the supply of physicians, but its effect on NPs and PAs has not yet been studied empirically. NPs and PAs may respond similarly to physicians, but licensing laws and vicarious liability complicate this effect by allowing patients to hold supervising physicians liable for the mistakes of NPs and PAs. For example, if a state decreases required physician oversight of NPs and PAs, plaintiffs may be better able to hold the NP or PA liable and may not be able to sue the supervising physician for the supervisee's errors. In the most extreme case—when NPs may practice independently—NPs bear the full cost of their liability since patients cannot sue a supervising physician. Thus, licensing laws may dampen the incentives created by legal liability for NPs and PAs.

This chapter extends the literature on occupational licensing laws and begins to fill the gap in the malpractice literature by examining the effect of these two legal regimes on the supply of NPs and PAs. It is the first to empirically examine the effect of malpractice reforms on NPs and PAs and the first to examine the effect of occupational licensing laws on practicing NPs and PAs across all fifty states over time. I find that both licensing and liability laws affect the supply of NPs and PAs. Allowing NPs to practice independently of physicians results in a 60% increase in the number of NPs per capita. Collateral source rule reform increases the number of NPs by nearly 20%. Interestingly, tort reform affects independently practicing NPs differently than NPs requiring physician supervision, suggesting that NPs react differently to legal liability when they bear the full costs of that liability. The evidence consistently shows that granting PAs full prescriptive authority increases the supply of PAs and that noneconomic damages caps reduce the supply of PAs. Additionally, an increase in the supply of physicians increases the supply of NPs and PAs, but the size of this increase depends on the licensing and liability laws in place.

Because state licensing and liability laws may be endogenously determined with the supply of healthcare providers, I consider the effect of changes in neighboring states' laws on the supply of NPs and PAs in counties bordering those neighboring states. These models, in addition to providing support for the evidence above, suggest that granting NPs full prescriptive authority increases the supply of NPs and allowing PAs to practice at sites away from their supervising physicians increases the supply of PAs. The next section provides some background on NPs, PAs, the laws that govern them, and previous research on those laws.

II. Background and Previous Research

A. Occupational Licensing Laws Governing NPs and PAs

The NP and PA professions both emerged in the 1960s. Both professions may diagnose and treat patients, order and interpret tests, and write prescriptions. Typically, NPs complete one to two years of additional study beyond that required of RNs with bachelor degrees. PAs generally complete 18 months to three years of training beyond an undergraduate degree, and they must typically possess some healthcare experience prior to beginning their training. NPs and PAs function similarly to physicians in a variety of settings and often perform as well or better than physicians in providing care within their education and training (Newhouse et al. 2011; Naylor and Kurtzman 2010). Relative to physicians, a greater proportion of NPs and PAs practice in primary care settings. In 2011, about 50% of NPs and almost 45% of PAs practiced in primary care settings (Stange 2014). The remaining NPs and PAs practice in a variety of specialty care environments.

The occupational licensing laws governing the practices of NPs and PAs vary substantially across states. While these laws govern most aspects of an NP's or PA's practice,

including professional entry requirements, billing/reimbursement, and continuing education, two important categories of laws determine how they can serve their patients: scope of practice laws determine what types of healthcare services NPs and PAs may provide, and supervision laws govern the level of physician involvement in NP and PA practices.

Within scope of practice laws, I focus on the authority of NPs and PAs to write prescriptions since this authority is integral to the practices of most NPs and PAs. Historically, NPs and PAs could not prescribe any controlled substances in many states, but every state except Florida now allows them to prescribe some controlled substances.[30] States fall into two basic categories: those granting NPs and PAs the authority to prescribe essentially all controlled substances that physicians may prescribe and those restricting the prescriptive authority of NPs and PAs more than physicians.

NP supervision laws fit into three basic groups: those requiring no physician supervision (independent practice), those requiring physician supervision of NPs when they prescribe medications (prescription supervision), and those requiring physician supervision of all aspects of an NP's practice (complete supervision). Differences in PA supervision requirements are subtler because, by their nature, PAs are always tethered to a physician. However, states differ on whether the PA's supervising physician must be on the premises when she is providing care (onsite supervision) or not (remote practice).

In general, prescriptive authority and supervision requirements are not jointly determined, so the ability to practice with relatively little physician supervision does not imply the authority

[30] Controlled substances are a subset of medications that the Drug Enforcement Agency and Food and Drug Administration have determined are dangerous enough to warrant increased oversight. Controlled substances are categorized into five schedules. Schedule I drugs are banned, schedule II drugs have a high potential for abuse and may have severe side effects, and the remaining schedules III through V decrease in potential for abuse and risk of harmful side effects.

to prescribe the same medications as physicians and vice versa. Only in rare instances do states simultaneously decrease physician supervision requirements and increase NP or PA prescriptive authority.

The existing research on occupational licensing focuses primarily on licensing laws as barriers to entry rather than on their role in governing how individuals practice their profession or how different professions interact with one another in the same market. Kleiner (2006) provides an overview of the theoretical treatment of occupational licensing laws and posits that occupational restrictions are associated with higher prices and lower quantity but not necessarily higher quality. Dueker et al. (2005) and Perry (2009) examine the effects of broader advanced practice nurse (APN) and PA licensing laws on healthcare provider wages.[31] Dueker et al. (2005) find that broader APN laws lead to a decrease in APN and physician wages but an increase in PA wages. However, Perry (2009) finds that broader NP laws lead to increased NP wages and decreased physician wages, while broader PA licenses decrease NP and physician wages but have little effect on their own wages.

Previous research has found mixed evidence of the effect of broader NP and PA licensing laws on healthcare markets. Kleiner et al. (2014) find that when state laws allow NPs to perform more services without physician supervision, the price of a common medical examination decreases. However, Stange (2014) finds that an increase in NP and PA supply has only small effects on the office-based healthcare market but has a larger effect on healthcare utilization in states that grant broader licenses. Traczynski and Udalova (2014) find that the number of routine checkups and other measures of healthcare quality increase when NPs can practice more independently. Spetz et al. (2013) find that when patients visit retail health clinics, the total cost

[31] Advanced practice nurses include NPs as well as clinical nurse specialists, certified registered nurse anesthetists, and certified nurse midwives.

associated with an episode of illness/injury decreases and that this decrease is greater in states allowing greater NP authority. Kuo et al. (2013) find that NPs see more Medicare patients in states with broader licensing regimes.

However, these studies do not focus on how regulations affect the supply of providers. Stange (2014) has information on NPs and PAs over an 18-year period for 25 states (and more states in the later part of his period), but he focuses primarily on the effects of changes in the supply of NPs and PAs and not on the determinants of supply. Additionally, his primary measure of regulation is a time-invariant index of laws. [32] This chapter extends his work using data over a shorter time period but covering all fifty states and by measuring specific types of laws in place at different times.

Other work has focused more specifically on the determinants of the supply of NPs and PAs, including occupational licensing laws. Sekscenski et al. (1994) construct a state law index for PAs, NPs, and certified nurse midwives and find that broader licenses are positively correlated with the supply of relevant providers. Declerq et al. (1998) focus on certified nurse midwives and find similar results. However, both of these studies are cross-sectional. Kalist and Spurr (2004) use a fixed-effects model to estimate the effect of broader APN licensing laws on enrollment in APN educational programs. They find that enrollment is 30% higher in those states with broader licensing laws. However, this conclusion may not extend to practicing professionals since many NPs and PAs may practice in different states from where they received their training.

This chapter extends the current literature by using a fixed effects approach to estimate the impact of contemporaneous laws on practicing NPs and PAs across all fifty states. However, licensing laws are not the only means by which NPs and PAs are regulated. Because they can be

[32] Stange (2014) includes an indicator for whether NPs and PAs possess any prescriptive authority in the later part of his paper.

sued just like physicians, NPs and PAs are regulated by state tort law. However, there is next to no evidence on how malpractice laws and malpractice reforms affect NPs and PAs.

B. NP and PA Malpractice Liability

When an NP or PA harms a patient, that patient may sue the NP or PA for malpractice. If the NP or PA is supervised by a physician, the patient can usually sue the physician under a theory of vicarious liability as well. Most states require physicians supervising PAs to explicitly accept responsibility and liability for the mistakes of PAs under their supervision. Most states require that physicians supervising NPs be involved in the care of patients in some way in order for patients to sue those physicians (Buppert 2012). When NPs practice autonomously, patients do not have the option of suing a supervising physician. The ability of patients to hold physicians liable for the mistakes of NPs and PAs may dampen the effect of legal liability on the behavior of NPs and PAs, since these providers may not be required to pay the full costs associated with their medical errors.

While almost no evidence exists on the effect of malpractice liability on NPs and PAs, the effects of malpractice liability on the healthcare system and the potential of tort reform to dampen the negative effects have been debated for over twenty years (Avraham and Schanzenbach 2010). Proponents of tort reforms, such as the American Medical Association, assert that malpractice liability increases healthcare costs by encouraging physicians to order unnecessary and expensive tests primarily to avoid liability (sometimes referred to as defensive medicine). Proponents also assert that a greater potential for malpractice liability leads to physicians providing less care, retiring earlier, relocating to places with lower malpractice costs, or avoiding high risk patients (see Mello et al. 2006; Klick and Stratmann 2007). While most of

the debate over the effect of tort liability focuses on financial costs, physicians and other individual providers incur other costs as well, including the reputational harms associated with being sued, the time away from their practices, and the psychological impacts of enduring a lawsuit (Charles, Pyskoty, and Nelson 1988; Weiler et al.1993). These losses are not insurable in the way that damages awards are.

Tort reforms mitigate the effects of malpractice liability by decreasing the expected malpractice costs for healthcare providers. In this chapter, I focus on what have been generally established in the literature as major reforms (see Avraham and Schanzenbach 2010). First, noneconomic damages caps limit the ability of plaintiffs to recover damages for non-quantifiable injuries such as pain and suffering. Because caps vary, I use Avraham's (2011) "clever" definition of a cap.[33] These caps have been set low enough and have few enough exceptions to effectively limit damages awarded at trial. Second, collateral source rule reform changes the traditional tort doctrine that prevents defendants from introducing evidence that plaintiffs have obtained compensation for their injuries from other sources—usually health insurance. With this reform, the amount of damages for which the defendant is liable may be reduced by the amount of the plaintiff's other compensation.

While noneconomic damages caps generally have the strongest effect on physician supply (see Mello and Kelly 2005), collateral source rule reform may be more important for NPs and PAs. Noneconomic damages caps only reduce liability for a certain type of damages and only when those damages exceed a certain threshold. Collateral source rule reform has the potential to reduce the amount of damages for which a healthcare provider may be liable at all levels of damages. If NPs and PAs routinely incur lower levels of damages than physicians,

[33] This definition is based on Avraham's "clever" database of tort reforms.

which is likely given the differences in their practices, collateral source rule reform may affect NP and PA supply to a greater extent than noneconomic damages caps.

Finally, joint and several liability reform amends the traditional rule of joint and several liability, which allows a plaintiff to recover the full amount of damages from any single defendant even when multiple defendants were held liable for the injury. With this reform in place, plaintiffs may only recover damages from each defendant commensurate with her proportion of liability.[34] Unlike the other reforms which unambiguously reduce the expected liability of potential defendants, joint and several liability reform may increase or decrease the expected liability of potential defendants depending on whether they are likely to be the single payer under the traditional joint and several liability rule or to be one of the multiple defendants who escape payment.

The existing studies on the effects of malpractice law focus almost exclusively on physicians and (sometimes) hospitals. The evidence suggests that tort reforms mitigate some of the problems associated with malpractice liability but is mixed on how substantially tort reforms impact the healthcare system. Kessler and McClellan (1996) and Dubay et al. (1999) find that after the adoption of tort reforms, physicians choose cheaper treatments with no decline in patient outcomes. However, Currie and Macleod (2008) and Dhankhar, Khan, and Bagga (2007) find that physicians choose more intensive and more expensive forms of treatment when tort reforms protect them from liability. Sloan and Shadle (2009) find no evidence that tort reforms reduce Medicare spending.

With respect to the supply of physicians, the evidence suggests that states with tort reforms have more physicians and have higher physician growth. Mello and Kelly (2005) find

[34] Specific formulations of this rule vary by state. Some states still allow plaintiffs to recover the entire award from a single defendant if that defendant's liability exceeds a certain liability proportion threshold.

that physicians avoid certain jurisdictions because of high malpractice premiums, and states with tort reforms have lower malpractice premiums (Thorpe 2004; Danzon et al. 2004; Baicker and Chandra 2005; Viscusi and Born 2005). Klick and Stratmann (2007) and Encinosa and Hellinger (2005) find that states with noneconomic damages caps have more physicians. Similarly, Kessler, Sage and Becker (2005) find evidence that tort reforms increase the supply of physicians. Later studies have demonstrated that much of the change in the supply of physicians is concentrated in areas that previously did not have access to physicians (Wolfson 2005; Matsa 2007). Klick and Stratmann (2007) show that specialist physicians respond more to tort reforms than general practitioners and primary care physicians. Helland and Showalter (2009) find that physicians exposed to more liability work fewer hours and that this effect is stronger for older physicians. Their findings suggest that in addition to increasing the number of physicians, tort reforms can increase the number of hours of care provided by physicians.

III. Model and Theoretical Framework

To develop intuition behind the anticipated effects of licensing and liability laws, I develop a straightforward model. The purpose of the model is to inform empirical intuition and generate testable hypotheses, not to serve as a fully specified general equilibrium model of the location decisions of regulated providers. The model is based on that of Matsa (2007), which was based on the model developed by Bresnahan and Reiss (1991). Here, I focus on NPs, but replacing NPs with PAs yields the same conclusions.

Suppose that markets for healthcare services delivered by NPs consist of undifferentiated NPs and that these providers are symmetric Bertrand-Nash competitors.[35] Further suppose that

[35] In this model of competition, each competitor chooses a price to supply an equal portion of the market demand.

the long-run equilibrium requires that the net incomes of NPs equalize across markets (so that there is no incentive to switch markets). The supply of NPs in a given market is given by S_N. These providers split the demand, *D(P)*, at price, *P*, equally, and each provider serves *D(P)/(S_N)* consumers. NPs face fixed costs, *F*, and marginal costs, *c*, and they make profits $\bar{\pi}_N$. They also risk incurring damages, *H*, from a malpractice suit with probability *q*. Similar to Shavell (2004), let these expected costs of malpractice be proportional to the amount of demand each provider serves. In a market without licensing laws and without tort reform, NPs will enter the market until the following equation holds:

$$(P - c - qH)\frac{D(P)}{S_N} - F = \bar{\pi}_N \tag{10}$$

The first term in this expression, $(P - c - qH)$, is the profit earned from meeting one unit of demand, and $\frac{D(P)}{S_N}$ is the total demand met by each individual NP. In equilibrium, the total profit of an individual NP must equal the profit earned by every other NP in every market. When this equation holds, there is no incentive for any individual NP to switch markets. Adding licensing and liability laws, let $l \in (0,1]$ and $t \in (0,1]$ capture the degree of licensing laws and tort reforms respectively. Similar to Kleiner and Park (2010) and Kleiner et al. (2014), let *l* represent the proportion of the profit retained by NPs with $(1 - l)$ going to physicians. When licensing laws require no physician supervision, $l = 1$, and as the strictness of regulation increases, *l* approaches 0. As *t* approaches 1, tort reforms effectively eliminate all expected liability costs, and if $t = 0$, then tort reforms either do not exist or offer no protection from expected liability costs. Adding these legal variables to the markets and ignoring fixed costs, NPs will enter until the following holds:

$$l(P - c - (1 - t)qH)\frac{D(P)}{S_N} = \bar{\pi}_N \quad (11)$$

In equation (11), *l* captures both the profits retained by NPs as well as a transfer of expected liability to physicians that comes with supervision. The latter is consistent with vicarious liability doctrines that allow injured patients to sue an NP's supervising physician for the negligence of the NP. When $l = 1$, so that no physician supervision is required, there is no transfer of expected liability costs.

Using equation (11), I develop empirically testable hypotheses about the effects of licensing and liability laws. Solving for S_N in equation (11) and differentiating yields the following:

$$\frac{\partial S_N}{\partial l} = \frac{D(P)(P - c - (1 - t)\mathrm{q}H)}{\bar{\pi}_N} > 0 \quad (12)$$

$$\frac{\partial S_N}{\partial t} = \frac{lD(P)qH}{\bar{\pi}_N} > 0 \quad (13)$$

$$\frac{\partial^2 S_N}{\partial l \partial t} = \frac{D(P)qH}{\bar{\pi}_N} > 0 \quad (14)$$

Equation (12) captures the effect of increasing the breadth of licensing laws. Unsurprisingly, granting NPs more authority or more autonomy leads to an increase in the supply of NPs (assuming that NPs make positive profits from satisfying demand). Equation (13) demonstrates that NPs respond similarly to tort reforms. As they receive more protection from liability, their numbers increase.

In equation (14), as NPs gain greater authority and as tort reform reduces expected damages to a greater degree, the supply of NPs increases beyond what it would have in response to changes in licensing or liability laws alone. Essentially this equation suggests that with no

supervising physician to "absorb" some of the NP's liability, NPs face the full costs of their mistakes and respond more strongly to tort reforms (i.e., the effect of tort reforms are magnified for NPs practicing with less physician involvement relative to NPs practicing with more physician involvement). Equation (14) also implies a different joint effect of tort reforms and licensing laws on NPs and PAs. Because PAs are always tethered to physicians while some states allow NPs to sever all ties to physicians, the maximum value of *l* for NPs is greater than the maximum value of *l* for PAs. Therefore, the effect of tort reforms on PAs with relatively more independence should be smaller than the effect of tort reforms on NPs with relatively more independence.

I test the predictions in equations (12) – (14) below; however, when testing these predictions, three considerations are relevant. First, the estimated effects of licensing and liability laws on the supply of NPs and PAs should be larger than the effects of tort reform (and other legal changes affecting costs) on physicians. As Danzon et al. (1990) and Matsa (2007) note, if market demand for healthcare services is inelastic, changes in cost (such as decreased expected liability) will not have very large effects on the supply of healthcare providers. However, as the market demand for healthcare services becomes more elastic, the effect of changes in cost on the supply of providers becomes larger. In general, the demand for physician services is likely more inelastic than the demand for NP or PA services, implying that the effect of changes in cost on physician supply should be smaller than the effect of changes in cost on NP and PA supply.[36]

[36] For example, a significant increase in the price of an appendectomy will likely not have a substantial effect on the demand for this service given the necessity of this service to preserve life. Therefore, an increase in the price of appendectomies will likely not have an effect on the supply of physicians providing this service. However, an increase in the price of visiting an NP at a retail health clinic may have a large effect on the demand for this service. In other words, the demand for services provided by physicians is likely less elastic than the demand for services provided by NPs and PAs.

Second, the model above assumes that provider-induced demand is not a significant problem. Provider-induced demand occurs when healthcare providers are able to increase the demand for healthcare services beyond what patients would prefer to consume because providers and patients have asymmetric information about the need for additional services. Concerns about induced demand are generally strongest for additional diagnostic procedures when the provider has a financial interest in the diagnostic equipment, which is often not the case with NPs and PAs (Mitchell and Scott 1992). Additionally, Madden et al. (2005) find that provider-induced demand is not a significant problem for primary care and the types of services routinely provided by NPs and PAs. However, if NPs and PAs are able to induce demand for their services, for example by requiring monthly follow-up visits by patients whose health status necessitates visits only every three months, then the effects of licensing and liability laws may be dampened relative to what they would be absent the ability of providers to induce demand.

Finally, this model assumes a static role of physicians in the demand for NP and PA services across licensing and liability regimes. Physicians may be competitors in the provision of healthcare services or demanders of NP and PA services depending on licensing laws, liability laws, and the preferences of physicians. If physicians change their behavior toward NPs and PAs in response to changes in laws, this could result in deviations from the predictions of the model above. For example, if physicians prefer to treat (and bill) more patients when they are protected from liability, this may result in a decrease in the demand for NP and PA services and, in turn, the supply of NPs and PAs. I control for the supply of physicians in all empirical models below. I also empirically examine how the effect of physician supply on NP and PA supply varies across licensing and liability regimes. Before doing so, the next section provides an overview of the data I use.

IV. Data

A. Measures of licensing and liability laws

I obtained initial information on NP and PA licensing laws from *The Nurse Practitioner*'s annual legislative updates and from several editions of *Physician Assistants: State Laws and Regulations*. I augmented this initial information on NP and PA licensing laws with information directly from state statutes, regulations, and court cases using Westlaw and LexisNexis. Obtaining information directly from legal databases allowed me to consistently code different state laws without having to rely exclusively on different secondary sources, which may include inconsistent statutory interpretation. Researchers have coded state laws differently based on focus but I focus on laws regulating scopes of practice and physician supervision. To isolate the effects of individual laws, I use indicator variables for different state laws throughout my analysis instead of creating an index of different legal environments.

For scope of practice laws, I focus on laws preventing NPs and PAs from prescribing the same range of medications as physicians. Figures 1 and 2 show which states restricted NP and PA prescription authority, respectively, in 2001 and 2013. There is no perfect overlap of states authorizing all controlled substances for NPs and PAs. In both years, NPs could prescribe the full range of controlled substances in more states than PAs, and the number of states authorizing NPs and PAs to prescribe all medications increased from 2001 to 2013.

Restrictions on the abilities of NPs and PAs to prescribe the full range of therapeutic drugs limit the flexibility of these providers in caring for their patients. Often, NPs and PAs appeal to consumers because they are willing to provide care at locations that are convenient, such as retail health clinics, or where the availability of physicians is limited, such as rural areas

(Stange 2014; Kleiner et al. 2014). However, if NPs and PAs cannot provide the full range of healthcare services, their appeal to consumers may be limited, which will likely reduce the number of NPs and PAs in a given market.

For NP supervision laws, I group states into three levels of supervision: independence, prescription supervision, and complete supervision. States are coded as allowing NP independence if they do not require physician supervision or collaboration for any part of an NP's practice. States are coded as requiring prescription supervision if NPs cannot prescribe without a supervising or collaborating physician but can practice otherwise without physician oversight. States that prohibit NPs from practicing without a supervising or collaborating physician are coded as requiring complete supervision. Lower supervision requirements allow NPs greater flexibility in when and where they provide care and decrease the administrative burdens on their practices, both of which should increase the number of NPs in a given market.

For PAs, I focus on whether states require the presence of a PA's supervising physician when the PA is providing care more than once a month. States are coded as allowing remote PA practice if they do not require that the physician be onsite when the PA is providing care more than once per month. Otherwise, states are coded as having an onsite requirement. Similar to independence for NPs, the absence of an onsite requirement for PAs allows them more flexibility in providing care and allows them to better meet consumer demands for convenient care. Figure 3 shows states' required levels of supervision for NPs in 2001 and 2013, and figure 4 shows which states allowed remote PA practice in 2001 and 2013, respectively. As with scope of practice laws, these figures show state variation in NP and PA supervision laws. They also illustrate that there is no one-to-one correlation between states authorizing NP independence and

states authorizing remote practice for PAs. The overall trend has been toward requiring less physician supervision of NPs and PAs.

I obtained information on state tort reforms from the Database of State Tort Law Reforms (DSTLR) compiled by Avraham (2011). Using the statutory citations in the DSTLR and additional legal searches, I extend the time period covered by the DSTLR to include all years for which I have data on the supply of NPs and PAs. I collect information on the three major tort reforms discussed above; however, I use Avraham's "clever" definition of noneconomic damages caps instead of simply coding every noneconomic cap.[37] Figures 5 – 7 show the evolution of different tort reforms from 2001 to 2013, with the overall trend being toward more tort reforms.

B. Information on the supply of providers and healthcare markets.

Almost all of the data used in my analysis come from the Area Health Resource File (AHRF) compiled by the Health Resources and Services Administration. The AHRF consists of data collected from a variety of different sources and provides information at the county level. Information on the number of NPs and PAs in each county for the years 2010 – 2013 comes from the National Plan and Provider Enumeration System (NPPES) and includes all NPs and PAs with a national provider identifier (NPI). An NPI uniquely identifies a provider and, once obtained, remains with the provider for her entire career. With each NPI, the NPPES includes the provider's business address and the provider's type (physician, NP, PA, dentist, optometrist, etc.) Beginning in 2007, all HIPAA covered healthcare providers (which includes NPs and PAs) were

[37] Avraham's "clever" definition of noneconomic damages caps includes only caps set low enough and which include few enough exceptions to effectively limit noneconomic damages. This definition excludes caps with high thresholds and caps with exceptions that make them ineffective.

required to acquire an NPI for use in all HIPAA covered transactions. Researchers conducted the National Sample Survey of Nurse Practitioners in 2012 and obtained information directly from state boards of nursing. They estimated that over 90% of all NPs had an NPI number in 2012. [38] Similar estimates are not available for PAs. All providers are legally required to update their practice address when they change locations, so these data accurately track the movements of NPs and PAs across the country.

Because the NPPES data only cover 2010 through 2013, I also use data included in the AHRF gathered by professional organizations for NPs and PAs in 2001. Including these additional years results in a temporal gap in the data but allows for more variation in state laws, which aids in identifying my empirical models similar to Helland and Showalter (2009). Physician supply data in the AHRF come from the Physician Masterfile compiled by the American Medical Association. In addition to information on the supply of physicians, NPs, and PAs, the AHRF includes information on county demographics such as population, median household income, percent of the population in poverty, and the rural/urban status of the county. Also included for each county are the number of individuals with private health insurance and the number eligible for Medicare.

Table 1 provides overview of NP supply. Nationally, the average county has 30 NPs for every 100,000 residents. The remainder of the table reports the average NP supply in different legal regimes. The per capita supply of NPs is highest when NPs can practice independently, and states allowing NPs to prescribe a full range of medications have more NPs than states restricting the prescriptive authority of NPs. States with noneconomic damages caps have slightly more NPs

[38] The missing 10% may represent non-practicing NPs. The National Sample Survey of Nurse Practitioners sampled NPs that were not currently practicing, and if these NPs had not practiced since 2007, they would not appear in the NPPES data.

per capita, and the supply of NPs barely differs across states with and without collateral source rule reform and joint and several liability reform.

Table 2 reports summary statistics for PAs across the country. In general, there are fewer PAs than NPs, with the average county having around 20 PAs per 100,000 residents. As with NPs, states with broader licensing laws have more PAs per capita. States allowing PAs to practice remotely have almost 9 more PAs per capita than states requiring a greater degree of supervision, and states allowing PAs to prescribe essentially the same range of medications as physicians have over 10 more PAs per capita than states restricting PA prescriptive authority. PA supply differs across tort reforms to greater extent than NP supply. States with noneconomic damages caps have about 3 more PAs per capita than states without caps. States with collateral source rule reform have almost 50% more PAs per capita than states without this reform, and states with joint and several liability reform have about 2 more PAs per capita than states maintaining the traditional joint and several liability rule. The next section outlines an empirical strategy to estimate the effect of these licensing and liability laws on the supply of NPs and PAs.

V. Empirical Strategy

To estimate the causal effect of licensing and liability laws on the supply of NPs and PAs, I use two-way fixed effects models, which are generalizations of the standard difference-in-difference model. I use the following general specification:

$$\begin{aligned}\text{Log}(provider\ supply)_{cst} = {} & licensing\ laws'_{st}\beta_1 + tort\ reform'_{st}\beta_2 + \\ & (licensing\ laws) \times (tort\ reform)'_{st}\beta_3 + \\ & W'_{cst}\theta + X'_{cst}\lambda + Z'_{cst}\gamma + \delta_s + \tau_t + \varepsilon_{cst}\end{aligned} \tag{15}$$

The dependent variable, $\text{log}(provider\ supply)_{cst}$, is the natural logarithm of the number of NPs or PAs per 100,000 county residents, where c indexes counties, s indexes states, and t

indexes time. The vector $licensing\ laws_{st}$ includes indicator variables for supervision and scope of practice laws. For NPs, it includes indicators for whether NPs may practice independently, whether they must be supervised when prescribing, and whether they can prescribe the full range of controlled substances. For PAs, it includes indicators for whether PAs may practice remotely and whether they can prescribe all controlled substances.

The vector $tort\ reform_{st}$ includes indicators for whether a state has enacted a noneconomic damages cap, collateral source rule reform, and joint and several liability reform.[39] The interaction term $(licensing\ laws) \times (tort\ reform)_{st}$ includes interactions between each licensing law and tort reform indicator. W_{cst} includes the supply of office-based and hospital-based physicians.[40] I include physicians working in these two settings because they may have different financial incentives with respect to NPs and PAs. Office-based physicians may overlap more with NPs and PAs with respect to services provided than hospital-based physicians. Additionally, hospital-based physicians may be more likely to be employed by a larger organization and thus be less sensitive to the competitive effects of NPs and PAs. Because NPs and PAs are most likely forward looking, the number of physicians is lagged one year.

X_{cst} is a vector of variables for the percentage of the population covered by private health insurance and the percentage of the population eligible for Medicare. Z_{cst} is a vector of other county characteristics including whether the county is rural or semi-rural (the definitions of which are based on the Department of Agriculture's urban-rural continuum classification codes),

[39] I include only "clever" noneconomic damages caps as defined by Avraham (2011) in his "clever" database of state tort reforms.

[40] I include the natural logarithm of the number of physicians per 100,000 county residents. When calculating the natural logarithm of all provider types (including NPs, PAs, and different types of physicians), I add one to the number of providers per 100,000 to avoid dropping counties with no practicing physicians. Alternatively, I calculate the natural logarithm directly and replace the resulting undefined results with small number. The point estimates reported below change slightly (in no case by more than 0.01), but the statistical significance of the results below does not depend on the definition of the natural logarithm of provider supply.

the degree of urban influence in a county, lagged median household income, and county population density. To control for fixed unobserved determinants of provider supply across states and over time, I include state fixed effects, δ_s, and year fixed effects, τ_t.

I estimate separate models for NPs and PAs. In addition to estimating and reporting ordinary least squares regression models with standard errors clustered at the state level, I re-estimate (but do not report) all of the specifications reported below with bootstrapped standard errors to address concerns about small cell size.[41] The results from these alternative models are generally consistent with the results reported below with one exception, which I note below. The key parameters of interest are β_1, β_2, and β_3—the change in provider supply associated with moving from one legal regime to another. Table 3 provides an overview of the predicted effects for different licensing and liability law variables based on the model and theoretical predictions developed above. Each cell of the table reports the predicted net effect of the licensing law on the left and the tort reform above. However, these predictions assume a static response from physicians. In later specifications, I include interactions between the licensing and liability law indicator variables and the supply of physicians to examine how a change in the number of physicians may influence the number of NPs and PAs differently across different legal regimes.

Throughout the regression analysis, I exclude counties that have no practicing NPs or PAs. Doing so results in dropping approximately 10% of all counties in the case of NPs and approximately 20% of all counties in the case of PAs. However, I later estimate empirical models that explicitly account for the probability of a county having no practicing NPs/PAs and find that the point estimates are not meaningfully different and that the statistical significance of

[41] I do not estimate population weighted regressions because doing involves assumptions about the error structure that may be violated here (see Wooldridge 2004). Matsa (2007) includes population-weighted regressions in his analysis of the supply of physicians, but Klick and Stratmann (2007) and Lieber (2015) do not.

the results does not change. Additionally, licensing and liability laws are not strong predictors of whether a county has a positive number of NPs or PAs.

VI. Results and Discussion

A. The Effect of Licensing and Liability Laws on the Number of NPs and PAs

Table 4 reports OLS regression results with the natural logarithm of the number of NPs per 100,000 county residents as the dependent variable. Column (1) reports a specification that includes only licensing and liability law indicator variables, and column (2) reports the preferred specification, which includes indicators for licensing and liability laws as well as interactions between each. In all specifications, the omitted supervision law category is complete supervision, the omitted controlled substances authority category is limited controlled substances authority, and the omitted tort reform category is no major reform. Focusing on column (2), allowing NPs to practice independently of physicians increases the supply of NPs by about 60%,[42] which is consistent with the predictions from the model above. NP independence results in an increase in NP supply, while relaxing the supervision requirement from complete supervision to prescription supervision (captured by the *MD RX supervision* variable) has no effect on supply. This suggests that there is little practical difference among different levels of supervision, while removing supervision requirements altogether substantially affects NP supply.

Collateral source rule reform increases the supply of NPs by about 20%, and this effect is consistent with the predicted effects of tort reforms that reduce expected liability costs of NPs. The effect of noneconomic damages caps is similar to that of collateral source rule reform—it increases NP supply by around 20%—but this effect is not statistically significant. The effect of

[42] Because the estimated equation is in semi-logarithmic form, the estimated coefficient on and indicator variable must be transformed to obtain the marginal effect (see Halvorsen and Palmquist 1980)

collateral source rule reform and the lack of a statistically significant effect of noneconomic damages caps contrasts with the effect of tort reforms on physician supply (see, e.g., Klick and Stratmann 2007; Lieber 2015). Noneconomic damages caps may not affect NP supply the same way they affect physician supply if NPs do not regularly incur noneconomic damages in excess of cap amounts. Physicians, who likely address more complicated medical issues and employ treatments with higher risks of injury, may receive relatively more protection from noneconomic damages caps than NPs. On the other hand, collateral source rule reform can result in decreases in expected damages at any level of damages, so this reform may offer NPs more protection against legal liability and, therefore, affect NP supply to a greater extent than noneconomic damages caps.

In column (2), which allows tort reforms to affect NPs differently across licensing regimes, the estimated coefficients on the interaction terms between independent NP practice and all three major tort reforms are statistically significant. This implies that tort reforms affect independently practicing NPs differently than supervised NPs, consistent with the predictions above. Specifically, the interaction terms between NP independence and tort reforms suggest that NPs react more strongly to tort reforms when they are more exposed to liability. In other words, because independent NPs do not have supervising physicians to "absorb" some liability, the incentives created by that liability have greater effects on NP supply. The effects of collateral source rule reform and joint and several liability reform on independently practicing NPs are consistent with the theoretical predictions above since the effect of these tort reforms on NP supply are essentially magnified when NPs bear the full responsibility for their actions, i.e., when they practice independently.

The estimated coefficient on the interaction between NP independence and noneconomic damages caps implies that caps result in a net decrease in NP supply when NPs may practice independently, and this is not consistent with the predictions from the simple model above.[43] This negative effect may stem from changes in physician preferences and behavior towards NPs when NPs can practice independently and physicians are protected from some legal liability by noneconomic damages caps. If physicians provide more hours of care when protected from liability, consistent with Helland and Showalter (2009), and see more patients themselves, they may be less inclined to refer patients to independently practicing NPs, resulting in a decrease in NP supply. Alternatively, if noneconomic damages caps attract lower quality physicians, consistent with Lieber (2015), independently practicing NPs may prefer to avoid these physicians, resulting in a decrease in NP supply. I explore the effect of physician supply on NP supply across different legal regimes below.

In general, the supply of physicians affects the supply of NPs differently depending on where physician supply is concentrated. I estimate that a 10% increase in the number of office-based physicians per capita results in a 1.3% increase in the number of NPs per capita. However, a 10% increase in the number of hospital-based physicians only results in a 1% increase in the number of NPs. The estimated positive effects of rural and semi-rural status and negative effect of median household income are consistent with claims that NPs practice in out-of-the way locations and focus on relatively less affluent patient groups.

Table 5 reports regression results for the effect of licensing and liability laws on the supply of PAs. Again, column (1) includes only licensing and liability law indicator variables, and column (2) reports estimates from the preferred specification that includes all licensing and

[43] The same is true of the coefficient for the interaction between full controlled substances authority and noneconomic damages caps.

liability laws as well as interactions between the two. I estimate a negative effect for remote practice, but when the model is estimated with bootstrapped standard errors and when the effect of physician supply is allowed to vary by licensing and liability laws, the statistical significance of this effect disappears.[44] Additionally, this effect does not appear in the models designed to address the endogeneity of licensing laws discussed below, implying that this result is not robust and should be interpreted with caution.

When PAs possess full authority to prescribe controlled substances, the supply of PAs per capita increases by approximately 23%, which is consistent with the prediction that broader licensing laws increase PA supply. Among tort reforms, noneconomic damages caps reduce the number of PAs per capita by about 9%. This negative effect is similar to that estimated for independent NPs and may stem from the same underlying processes affecting how physicians interact with PAs once a cap is in place. Physicians may see more patients themselves (and bill at a higher rate) instead of relying on PAs when they are protected by noneconomic damages caps. Alternatively, if caps attract lower quality physicians, as Lieber (2015) shows, the relative mix of physicians in a jurisdiction may be less favorable toward PAs. I explore how the effect of noneconomic damages caps varies across different levels of physician supply below. While the estimated coefficients for collateral source rule reform and joint and several liability reform are not statistically significant, the direction of the effects is consistent with the effects they have on the supply of NPs.

Unlike NP supply, PA supply does not react different to tort reforms across licensing regimes. Because remotely practicing PAs do not lose the protection from liability that comes with having a supervising physician, they may not be exposed to substantially more liability in

[44] Models estimated with bootstrapped standard errors are available from the author upon request.

states allowing remote practice than states requiring more supervision. The lack of statistical significance for all of the licensing and liability law interaction terms is consistent with PAs not reacting differently to the incentives created by tort reforms across different licensing regimes.

The effect of an increase in the supply of physicians on the supply of PAs does not differ by whether that increase is concentrated among office-based or hospital-based physicians. A 10% increase in physicians per capita leads to almost a 1% increase in PAs per capita. Similar to NPs, I estimate a negative and statistically significant effect for an increase in median household income, and a positive effect for rural status. These effects are consistent with PAs practicing in rural locations and serving less affluent populations.

Table 6 repeats Table 3 above but reports estimated net effects instead of predictions. Each cell reports the net effect of the licensing law on the left and the tort reform above. In Panel A, most of the estimated effects for NPs are consistent with the predicted effects. Interestingly, the effect of having passed all major tort reforms on NP supply increases as physician supervision requirements for NPs decrease. This is consistent with NPs reacting more strongly to tort reforms as supervision requirements (and therefore liability protection) decrease. In Panel B, the effects of PA prescriptive authority are generally consistent with the predicted effects. Consistent with Danzon et al. (1990), Matsa (2007), and the discussion above, the estimated effects are generally larger than the effects of legal changes on physician supply.

B. The Effect of Physician Supply Across Licensing and Liability Regimes

Whether NPs and PAs possess broad or restricted licenses, physicians can wield substantial influence over their ability to meet the demand for healthcare services. This influence can be direct or indirect. For PAs and supervised NPs, physicians almost always retain the legal

authority to restrict the practices of their supervisees to a greater extent than state law does. Physicians may also indirectly influence NPs and PAs by facilitating or hindering patient referrals or by using their market power to affect NPs and PAs in other ways. If physician behavior or preferences toward NPs and PAs shift when the latter gain broader licenses or when a state enacts tort reforms, then the effect of an additional physician on the supply of NPs and PAs should differ across legal regimes.

These changes in preferences or behavior may mask the underlying effects of changes in licensing and liability laws on the supply of NPs and PAs, and this masking may be particularly relevant for the effect of noneconomic damages caps on the supply of NPs and PAs. Prior work has consistently found that noneconomic damages caps have the most substantial impact on physician supply and physician behavior (see, e.g., Matsa 2007; Helland and Showalter 2009). Therefore, among tort reforms, noneconomic damages caps are the most likely to change physician behavior towards NPs and PAs. Similarly, NP independence is the most likely candidate among licensing laws to affect physician preferences since this is the only licensing law that frees either NPs or PAs from physician involvement completely.

To test whether licensing and liability laws affect the supply of NPs and PAs via the supply of physicians, I use the same general specification discussed above augmented with interactions between licensing and liability law indicator variables and physician supply variables. Because I employ log-log specifications, the estimated coefficients for the supply of physicians are elasticities, and the interaction terms between physician supply and licensing and liability indicator variables represent changes in those elasticities.

Table 7 reports regression results for the effect of physician supply on NP supply across different licensing and liability regimes. The entire table reports results from a single regression.

Column (1) reports the main effects of different variables while columns (2) and (3) report the interactions between licensing and liability law variables and the supply of office-based and hospital-based physicians respectively.[45] I estimate an elasticity between NPs and office-based physicians of 0.217 and an elasticity between NPs and hospital-based physicians of 0.090. The effect of NP independence on NP supply is positive and statistically significant, but the elasticity between NPs and office-based physicians decreases to 0.144 when NPs can practice independently. Noneconomic damages caps have a positive and statistically significant effect, but the elasticity between NPs and office-based physicians is smaller in the presence of caps. The fact that I estimate a positive main effect and a smaller NP-to-office-based-physician elasticity for both independence and noneconomic damages caps suggests that at low levels of physician supply, independence and caps increase NP supply but that the size of this increase in supply becomes smaller as more office-based physicians enter a county.

As in earlier regressions, I estimate statistically significant coefficients for the interaction terms between NP independence and all three major tort reforms in column (1). The estimates for the interaction with collateral source rule reform and joint and several liability reform are consistent with earlier estimates. In contrast with earlier results, I estimate a positive net effect of noneconomic damages caps on both supervised and independent NPs. The estimated main effect of caps implies a 58% increase in NP supply in general, and the interaction between NP independence and caps implies a 36% decrease, resulting in a net positive effect of caps on independent NPs. This net positive effect of caps and the smaller elasticity between independent NPs and office-based physicians in the presence of caps implies that the negative net effect of

[45] A full set of regression results is available from the author upon request.

caps estimated in earlier regressions was driven primarily by changes in the relationship between NP supply and physician supply.

Table 8 reports regression results for the effect of physician supply on PA supply across different licensing and liability regimes. The columns are arrayed in the same manner as Table 7 with column (1) reporting main effects and the remaining columns reporting the interactions between licensing and liability law variables and the supply of office-based and hospital-based physicians. The base elasticities between PAs and office-based physicians and between PAs and hospital-based physicians are 0.161 and 0.139, respectively. In contrast to earlier regressions, the effect of remote practice is not statistically significant. However, the interaction reported in column (1) between remote practice and collateral source rule reform is significant, implying that in all states with collateral source rule reform (which is the majority of states), allowing PAs to practice remotely increases PA supply. Full prescriptive authority results in almost a 50% increase in the number of PAs, and the elasticity between PAs and physicians does not change with this authority.

In earlier regressions, I estimated a negative and statistically significant effect of noneconomic damages caps on PA supply. However, when the elasticity between PAs and physicians is allowed to vary across different legal regimes, I estimate a positive (but statistically insignificant) effect of caps. Thus, the current estimates demonstrate that the negative effect of caps works primarily through changes in the elasticity between PAs and physicians. Collectively, the estimates imply that when the supply of physicians is low, noneconomic damages caps increase the supply of PAs. As the supply of physicians increases, however, the total effect of noneconomic caps on PA supply becomes negative. For example, assuming zero hospital-based

physicians practice in a county, the total effect of noneconomic caps on PA supply is positive until the supply of office-based physicians per 100,000 residents increases above 50.

VII. Sensitivity and Robustness Analysis

Two problems may affect the results reported above. First, the results could be biased because I exclude all counties with zero NPs and PAs from the relevant specifications. Second, endogeneity bias may affect the results. I address both of these potential problems in this section. To confirm that dropping counties with zero NPs or PAs does not bias the results, I estimate Cragg's generalization of the tobit model (Cragg 1971). This model incorporates a probit model into the standard tobit model as a first stage to predict the probability that an observation is truncated at zero. In unreported regressions, I re-estimate all of the main specifications for both NPs and PAs. None of the estimated coefficients vary in any meaningful way in either magnitude or statistical significance from the results reported in the main tables above, and licensing and liability laws are not strong predictors of whether a county has any NPs or PAs.

If states respond to changes in provider supply by passing new occupational licensing laws or tort reforms, endogeneity bias may affect the results reported above. In earlier work, I demonstrated that states adopt occupational licensing laws governing NPs and PAs in response to changes in the political clout of physician, nurse, and hospital political interest groups. Almost all prior work on the effect of tort reforms on physician supply has treated those reforms as exogenous,[46] but recently some work has noted that states may pass tort reforms in response to

[46] Danzon (1984) and Campbell, Kessler, and Shepherd (1995) show that tort reforms, especially damages caps, generally do not respond to physician political power. Political groups associated with NPs and PAs do not prioritize medical malpractice reform as highly as physician groups in general, so if the latter do not affect the passage of tort reforms, that former likely affect tort reform even less so. Klick and Stratmann (2007) and Matsa (2007) treat tort reforms as exogenous. However, more recently, Lieber (2015) employs an empirical strategy to address potential endogeneity of tort reforms with physician supply.

specific trends in the healthcare industry (Lieber 2015; Danzon 2000). Thus, legislative endogeneity may affect the results for both licensing and liability laws.

To address this potential endogeneity bias, I use a similar empirical strategy as Lieber (2015). I examine changes in the supply of NPs and PAs in counties neighboring other states in response to changes in licensing and liability laws in the states they border. By focusing on changes in the laws of neighboring states, this strategy addresses the concern that states pass laws in response to unobserved factors that affect their healthcare workforces. This empirical strategy relies on the ability of providers in counties bordering other states to relatively easily relocate their practices to neighboring states in response to legal changes in those states.

I use the same general specification described above, but I drop all counties that do not border another state—this necessarily excludes all of Alaska and Hawaii. Each licensing and liability law indicator variable is coded as one if the neighboring state has passed the relevant law and the county's own state has not. When a county borders two different states, I use a population weighted (by border counties in those other states) average of the relevant laws in the other states similar to Lieber (2015). To be consistent with earlier results, these estimates should have the opposite sign from the estimates reported in Tables 4 and 5.[47]

Table 9 reports results for NP supply in counties that border another state. Column (2) reports the preferred specification. When a bordering state grants NPs independence and a county's own state requires supervision, the number of NPs per capita decreases by about 40%, which is consistent with earlier estimates for increases in NP supply when a state grants NPs independence. Interestingly, I estimate a statistically significant decrease in NP supply of over 30% in counties that border states granting NPs full prescriptive authority. This estimate implies

[47] They should have the opposite sign because in these border county specifications, I am essentially estimating whether a neighboring state's legal change "drains" NPs or PAs from a county bordering that state.

an increase in NPs in response to full prescriptive authority. None of the tort reform variables are statistically significant. If tort reforms have a subtler effect on the supply of NPs than licensing laws, which is consistent with earlier estimates, then retaining only 30% of the original sample may not be sufficient to observe that effect.

Table 10 reports results for the supply of PAs in counties that border other states. The results suggest a nearly 30% decrease in the supply of PAs in counties bordering states that allow PAs to practice remotely. The effect of full controlled substances authority is not statistically significant. However, the interaction between full controlled substances authority and collateral source rule reform is statistically significant and negative. Looking at the effect of controlled substances authority in jurisdictions which have enacted collateral source rule reform (which is the majority of states as evidenced by Figure 6), controlled substances authority has a negative effect on the supply of PAs consistent with the above estimates. While the effect of noneconomic damages caps is not significant in column (2), the sign and magnitude are consistent with earlier estimates, and the effect is significant in column (1). Overall, the regression results for border counties using neighboring states' laws are consistent with the results from the main empirical models.

VIII. Conclusion

This paper is the first to consider the joint effects of both licensing and liability laws on the supply of NPs and PAs across the country. These providers represent an important policy option for increasing the availability of healthcare. However, occupational licensing laws, which vary across states, often prevent NPs and PAs from providing the full range of care they are trained to provide. When states do not require physician supervision of NPs, the supply of NPs

increases by almost 60%. While the evidence from the main regression analysis does not suggest the supply of PAs increases when they can practice remotely, the border county regression results imply an increase in the supply of PAs when they face the least restrictive physician supervision requirements. I find evidence that the supply of PAs increases in response to laws that allow them to prescribe essentially the same medications as physicians. Evidence from the border county regressions implies a similar positive effect for NPs.

The evidence also suggests that tort reforms affect the supply of NPs and PAs. Their effects on NPs vary by whether states require supervision of NPs or allow them to practice independently. Collateral source rule reform has the strongest effect on the supply of NPs, increasing it by almost 20%. Tort reforms affect PAs somewhat differently than NPs. Some evidence suggests that collateral source rule reform increases the supply of PAs, but the effect is not as strong as it is for NPs. Noneconomic damages caps decrease the supply of PAs.

The effect of an increase in the supply of physicians on the supply of NPs and PAs differs across licensing and liability regimes. In general, an increase in the supply of physicians increases the supply of both NPs and PAs. When NPs can practice independently, the effect of an increase in the supply of office-based physicians on the supply of NPs is smaller. While the relationship between physician supply and PA supply does not vary across PA licensing laws, I find that the negative effect of noneconomic damages caps on PA supply works primarily through a change in the elasticity between PAs and physicians. This change, combined with a similar change in the elasticity between NPs and physicians in the presence of caps, suggests that caps may systematically alter how physicians behave toward both NPs and PAs.

As policymakers continue to debate the roles of NPs and PAs in the healthcare system, it is important to recognize the effect that both licensing and liability laws have on the supply of

these providers. In general, licensing laws play a greater role, but legal liability and tort reforms that mitigate it also play a role in determining NP and PA supply.

References

Avraham, Ronen. 2011. ‘‘Database of State Tort Law Reforms (DSTLR 4th),’’ Northwestern Law & Econ Research Paper No. 06-08; University of Texas Law, Law and Econ Research Paper No. 184. Available at SSRN: http://ssrn.com/abstrac1/4902711.

Avraham, Ronen, and Max Schanzenbach. 2010. “The Impact of Tort Reform on Private Health Insurance Coverage,” 10 *American Law and Economics Review* 319-355.

Auerbach, David. 2012. “Will the NP Workforce Grow in the Future?: New Forecasts and Implications for Healthcare Delivery.” 50 *Medical Care* 606-610.

Baicker Katherine, Chandra Amitabh. 2005. “The Effect of Malpractice Liability on the Delivery of Health Care,” in *Frontiers in Health Policy*, David Cutler and Alan Garber, Editors. Cambridge, Massachusetts, MIT Press.

Bresnahan, Timothy F., and Peter C. Reiss. 1991. “Entry and Competition in Concentrated Markets,” 99 *Journal of Political Economy* 977–1009.

Buppert, Carolyn. 2012. *Nurse Practitioner’s Business Practice and Legal Guide*. Bethesda, Maryland, Jones and Bartlett Learning.

Campbell, Thomas J., Daniel P. Kessler, and George B. Shepherd. 1995. “The Causes and Effects of Liability Reform: Some Empirical Evidence” National Bureau of Economic Research Working Paper No. 4989.

Charles, Sara C., Charlene E. Pyskoty, and Amy Nelson. 1988. “Physicians on Trial—Self-reported Reactions to Malpractice Trials” 148 *Western Journal of Medicine* 358-360.

Cragg, John. 1971. “Some statistical models for limited dependent variables with application to the demand for durable goods,” 39 *Econometrica* 829–844.

Currie, Janet, and W. Bentley Macleod. 2008. ‘‘First Do No Harm? Tort Reform and Birth Outcomes,’’ 123 *Quarterly Journal of Economics* 795–830.

Danzon, Patricia M. 1984. “The Frequency and Severity of Medical Malpractice Claims” 27 *Journal of Law and Economics* 115-148.

Danzon, Patricia M., “Liability for Medical Malpractice,” in Anthony J. Culyer and Joseph P. Newhouse, eds., *Handbook of Health Economics*, Vol. 1, Elsevier B.V., 2000, pp. 1341–1404.

Danzon, Patricia M., Andrew J. Epstein, and Scott J. Johnson. 2004. ‘‘The ‘Crisis’ in Medical Malpractice Insurance’’ in R. Harris and R. Litan, eds., Brookings-Wharton Papers on Financial Services. Washington, DC: Brookings Institution Press.

Danzon, Patricia M., Mark V. Pauly, and Raynard S. Kington. 1990. "The Effects of Malpractice Litigation on Physician's Fees and Incomes" 80 *American Economic Review* 122-127.

Declerq, Eugene, Lisa Paine, Diana Simmes, and Jeanne DeJoseph. 1998. "State Regulation, Payment Policies, and Nurse-Midwife Services," 17 *Health Affairs* 190–200.

Dhankhar, Praveen, Mahmud M. Khan, and Bagga Shalini. 2007. ''Effect of Medical Malpractice on Resource Use and Mortality of AMI Patients,'' 4 *Journal of Empirical Legal Studies* 163–83.

Dubay, Lisa, Robert Kaestner, and Timothy Waidmann. 1999. ''The Impact of Malpractice Fears on Cesarean Section Rates,'' 18 *Journal of Health Economics* 491–522.

Dueker, Michael J., Ada K. Jacox, David E. Kalist, and Stephen J. Spurr. 2005. "The Practice Boundaries of Advanced Practice Nurses: An Economic and Legal Analysis," 27 *Journal of Regulatory Economics* 309–329.

Encinosa, William E., and Fred J. Hellinger. 2005. ''Have State Caps on Malpractice Awards Increased The Supply of Physicians?,'' 24 *Health Affairs*, Supplement Web Exclusives 250–8.

Halvorsen, Robert & Raymond Palmquist (1980) "The Interpretation of Dummy Variables in Semilogarithmic Equations." 70 *American Economic Review* 474-475.

Helland, Eric, and Mark H. Showalter. 2009. ''The Impact of Liability on the Physician Labor Market,'' 52 *Journal of Law & Economics* 635–663.

Institute of Medicine. 2011. *The Future of Nursing: Leading Change, Advancing Health*. Washington, DC: The National Academies Press.

Gilman, Daniel J. and Tara Isa Koslov. 2014. "Policy Perspectives: Competition and the Regulation of Advanced Practice Nurses." Federal Trade Commission Report.

Kalist, David E. and Stephen J. Spurr. 2004. "The Effect of State Laws on the Supply of Advanced Practice Nurses," 4 *International Journal of Health Care Finance and Economics* 271–281.

Kessler, Daniel P., and Mark McClellan. 1996. ''Do Doctors Practice Defensive Medicine?,'' 111 *Quarterly Journal of Economics* 353–390.

Kessler, Daniel P., William M. Sage, and David J. Becker. 2005. ''Impact of Malpractice Reforms on the Supply of Physicians Services,'' 293 *Journal of the American Medical Association* 2618–2625.

Kleiner, Morris M. 2006. *Licensing Occupations: Ensuring Quality or Restricting Competition?*. Kalamazoo, Michigan, Upjohn Institute.

Kleiner, Morris M. and Kyoung Won Park. 2010. "Battles Among Licensed Occupations: Analyzing Government Regulations on Labor Market Outcomes for Dentists and Hygienists," NBER Working Paper No. 16560.

Kleiner, Morris M., Allison Marier, Kyoung Won Park, and Coady Wing. 2014. "Relaxing Occupational Licensing Requirements: Analyzing Wages and Prices for a Medical Service," NBER Working Paper No. 19906.

Klick, Jonathan, and Thomas Stratmann. 2007. ''Medical Malpractice Reform and Physicians in High Risk Specialties,'' 36 *Journal of Legal Studies* S121–42.

Kuo, Yong-Fang, Figaro Loresto, Jr., Linda Rounds, and James Goodwin. 2013. "States With the Least Restrictive Regulations Experienced the Largest Increase in Patients Seen by Nurse Practitioners," 32 *Health Affairs* 1236-1243.

Lieber, Ethan. 2015. "Medical Malpractice Reform, the Supply of Physicians, and Adverse Selection," *Journal of Law and Economics*, forthcoming.

Madden, David, Anne Nolan, and Brian Nolan. 2005. "GP Reimbursement and Visiting Behavior in Ireland" 14 *Health Economics* 1047-1060.

Matsa, David A. 2007. ''Does Malpractice Liability Keep the Doctor Away? Evidence from Tort Reform Damage Caps,'' 36 *Journal of Legal Studies* S143–S182.

Mello, Michelle, and Carly Kelly. 2005. ''Effects of a Professional Liability Crisis on Residents Practice Decisions,'' 105 *Obstetrics and Gynecology* 1287–95.

Mello, Michell, Allen Kachalia, and Sarah Goodell. 2006. "Medical Malpractice—Update." New Brunswick, NJ: Robert Wood Johnson Foundation, Research Synthesis Report #10.

Mitchell, Jean and Elton Scott. 1992. "Physcian Ownership of Physical Therapy Services: Effects on Changes, Utilization, Profits, and Service Characteristics" 268 *Journal of the American Medical Association* 2050-2054.

National Governors Association. 2012. "The Role of Nurse Practitioners in Meeting Increasing Demands for Primary Care." National Governors Association Paper.

National Governors Association. 2014. "The Role of Physician Assistants in Health Care Delivery." National Governors Association Paper.

Naylor, Mary and Ellen Kurtzman. 2010. "The Role of Nurse Practitioners in Reinventing Primary Care," 29 Health Affairs 893 – 899.

Newhouse, Robin P., Julie Stanik-Hutt, Kathleen M. White, Meg Johantgen, Eric B. Bass, George Zangaro, Renee F. Wilson, Lily Fountain, Donald M. Steinwachs, Lou Heindel,

and Jonathan P. Weiner. 2011. "Advanced Practice Nurse Outcomes1990-2008: A Systematic Review," 29 *Nursing Economics* 230-250.

Perry, John J. 2009. "The Rise and Impact of Nurse Practitioners and Physician Assistants on Their Own and Cross-Occupation Incomes," 27 *Contemporary Economic Policy* 491–511.

Shavell, Steven. 2004. Foundations of Economic Analysis of Law. Cambridge, Massachusetts, Belkknap Press of Harvard University of Press.

Sekscenski, Edward, Stephanie Sansom, Carol Bazell, Marla Slamon, and Fitzhugh Mullan. 1994. "State Practice Environments and the Supply of Physician Assistants, Nurse Practitioners, and Certified Nurse-Midwives" 331 *New England Journal of Medicine* 1266–1271.

Sloan, Frank A., and John H. Shadle. 2009. ''Is There Empirical Evidence for 'Defensive Medicine?' A Reassessment,'' 28 *Journal of Health Economics* 481–91.

Spetz, Joanne, Stephen T. Parente, Robert J. Town, and Dawn Bazarko. 2013. "Scope-Of-Practice Laws for Nurse Practitioners Limit Cost Savings that can be Achieved in Retail Clinics," 32 *Health Affairs* 1977-1984.

Stange, Kevin. 2014. "How Does Provider Supply and Regulation Influence Health Care Markets? Evidence from Nurse Practitioners and Physician Assistants," 33 *Journal of Health Economics* 1-27.

Thorpe, Kenneth E. 2004. ''The Medical Malpractice 'Crisis': Recent Trends and the Impact of State Tort Reform,'' 23 *Health Affairs*, Supplement Web Exclusives 20–30.

Traczynski, Jeffrey and Victoria Udalova. 2014. "Nurse Practitioner Independence, Health Care Utilization, and Health Outcomes" Working paper.

Viscusi, W. Kip, and Patricia H. Born. 2005. ''Damage Caps, Insurability, and the Performance of Medical Malpractice Insurance,'' 72 *Journal of Risk and Insurance* 23–43.

Weiler, Paul C., Howard Hiatt, Joseph P. Newhouse, William G. Johnson, Troyen Brennan, and Lucian Leape. 1993. A Measure of Malpractice: Medical Injury, Malpractice Litigation, and Patient Compensation. Cambridge, MA: Harvard University Press.

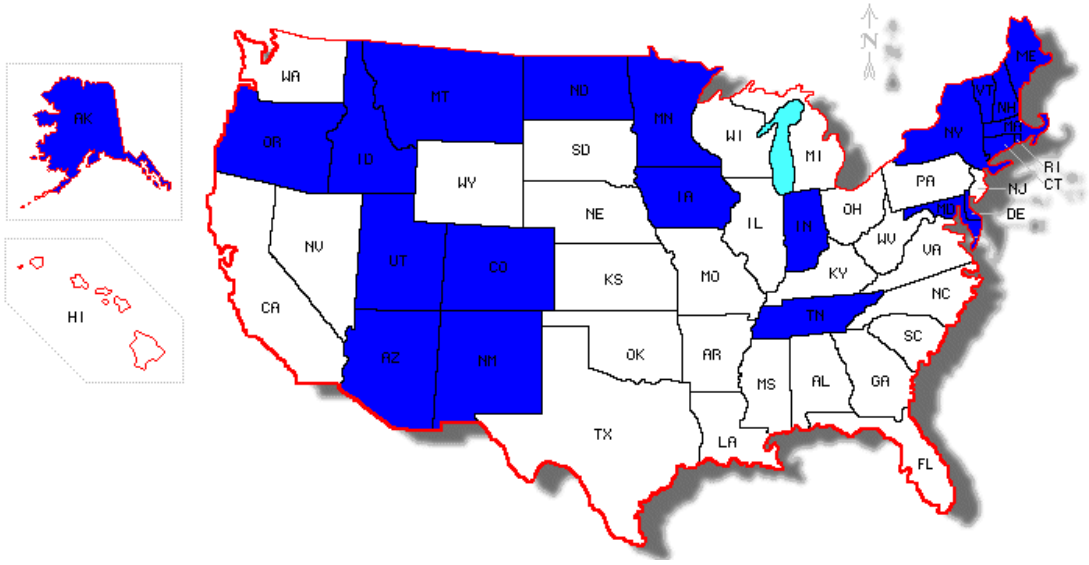
Wolfson, Jonathan. 2005. ''Does Tort Reform Increase Minority Access to Medical Care.'' Available at: www.pubchoicesoc.org/papers2005/Wolfson.pdf

Wooldridge, Jeffrey M. 2002. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, Massachusetts, MIT Press.

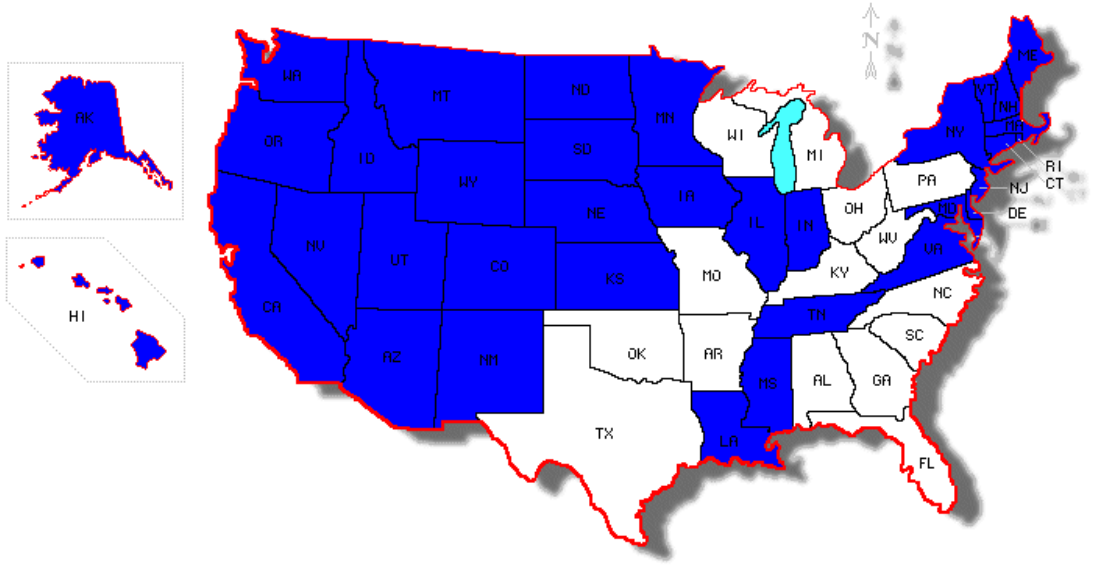
Tables and Figures

Figure 1: NP Prescription Authority

2001



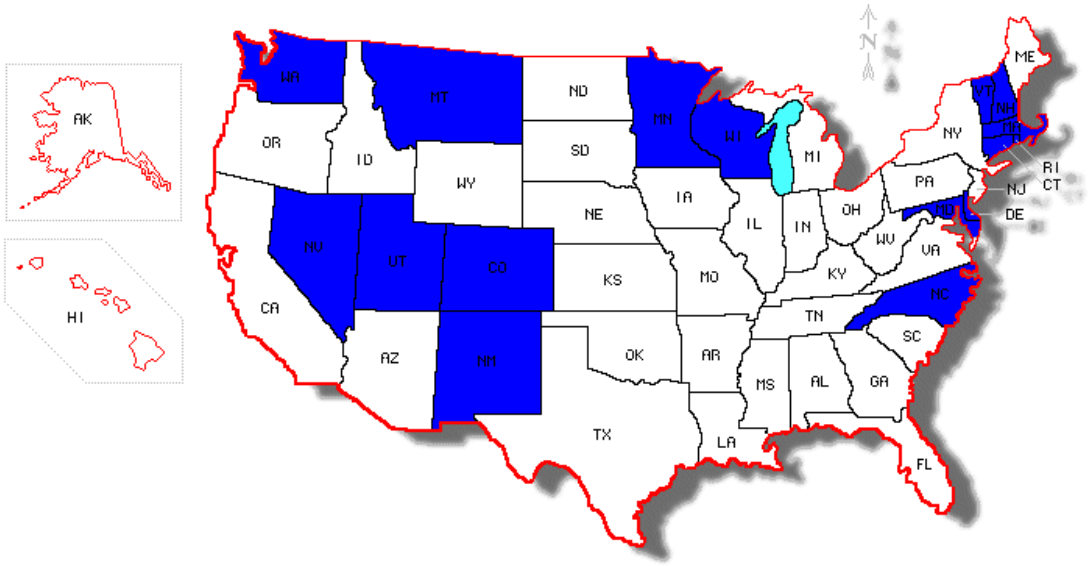
2013



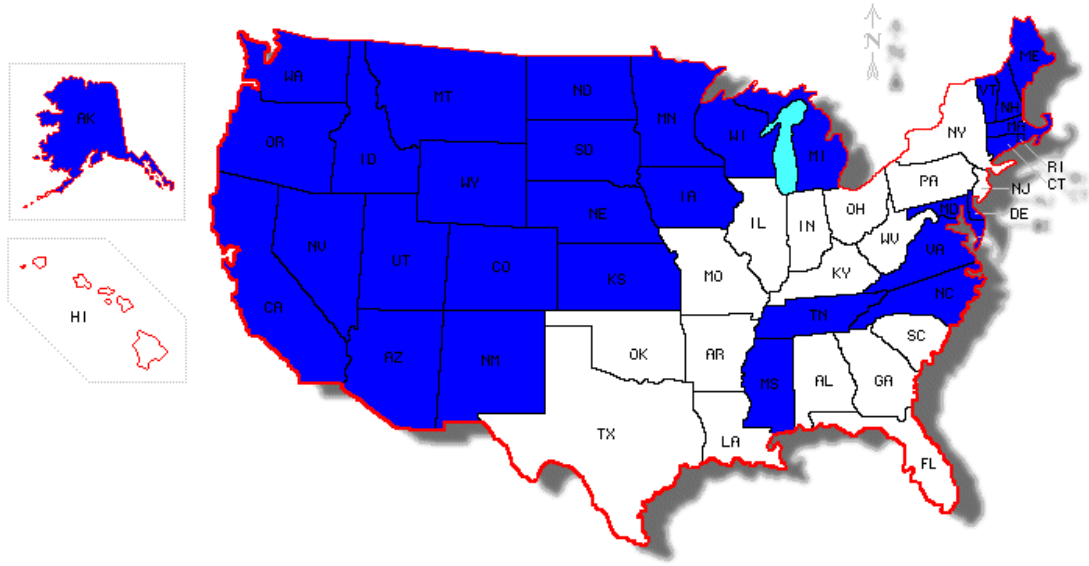
Full Prescriptive Authority

Figure 2: PA Prescription Authority

2001



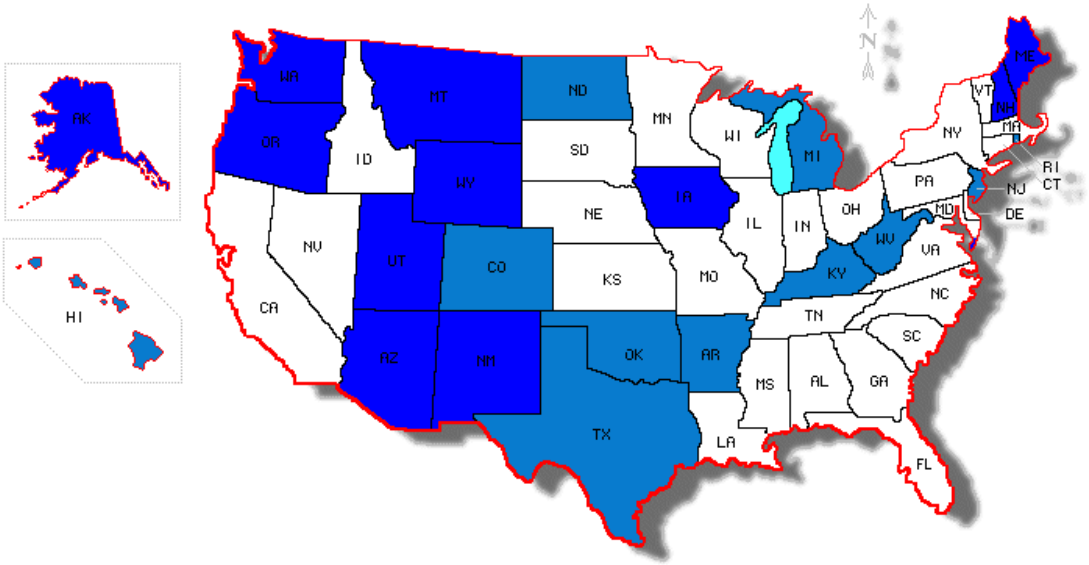
2013



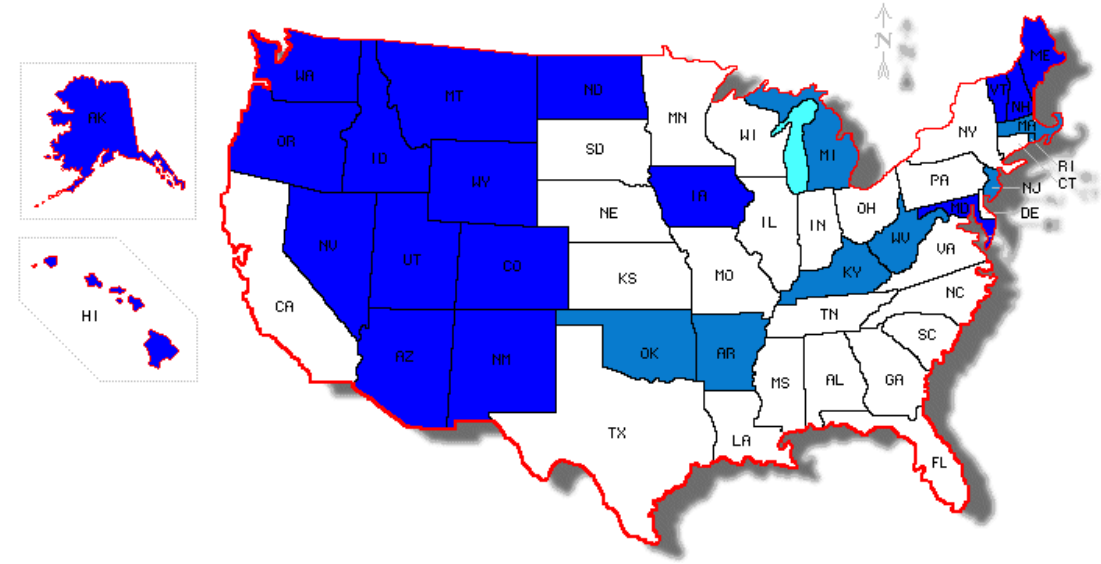
Full Prescriptive Authority

Figure 3: NP Supervision Laws

2001



2013

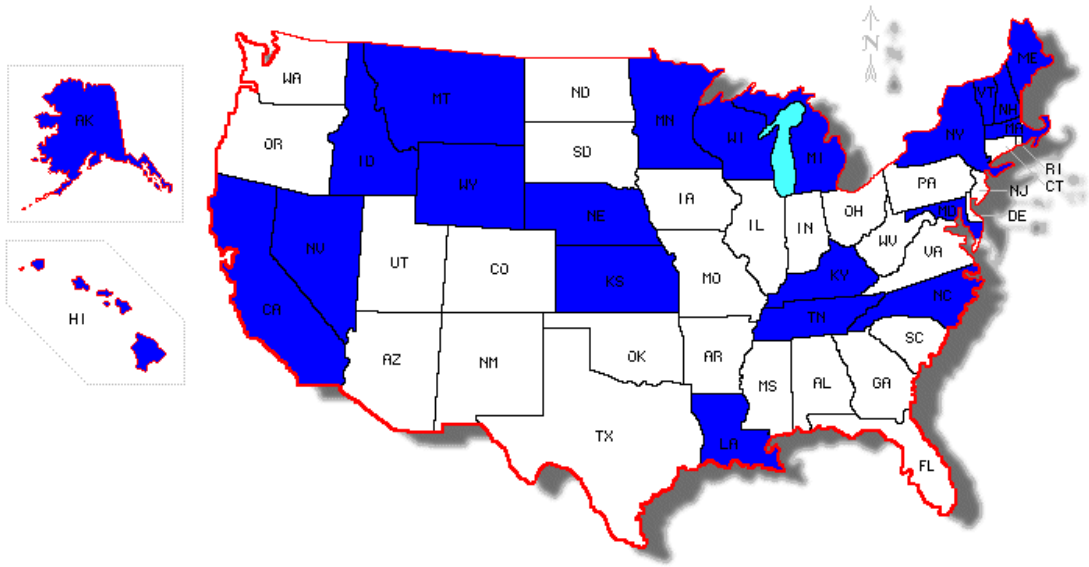


NP Independence

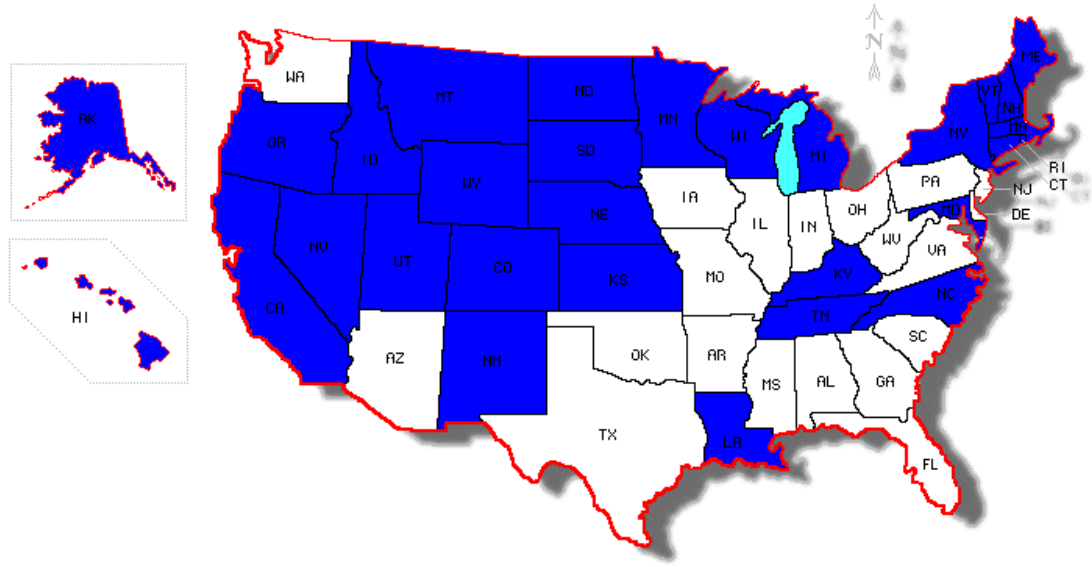
Prescription Supervision

Figure 4: PA Supervision Laws

2001



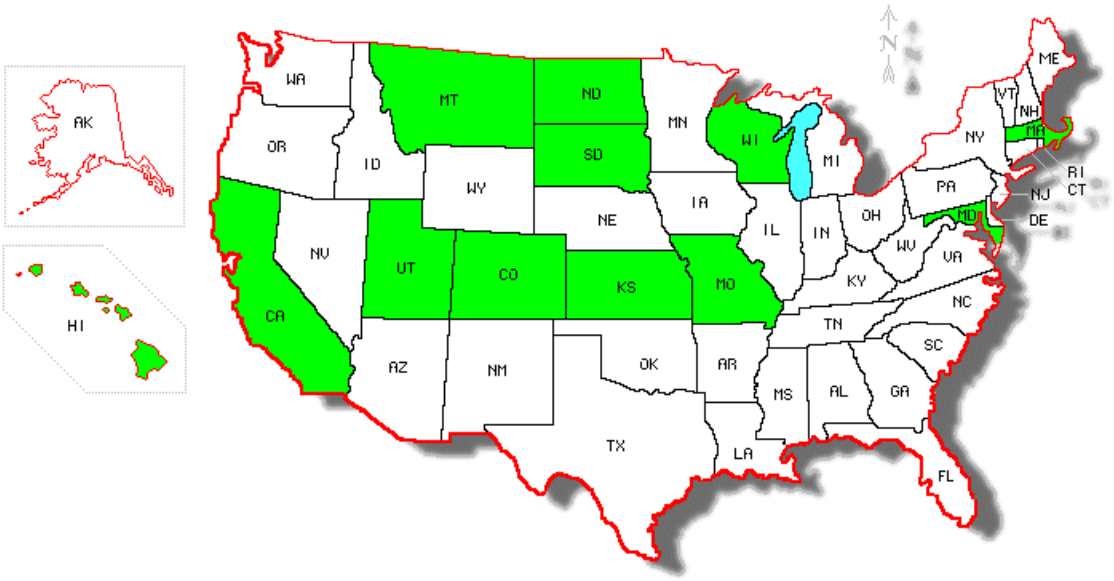
2013



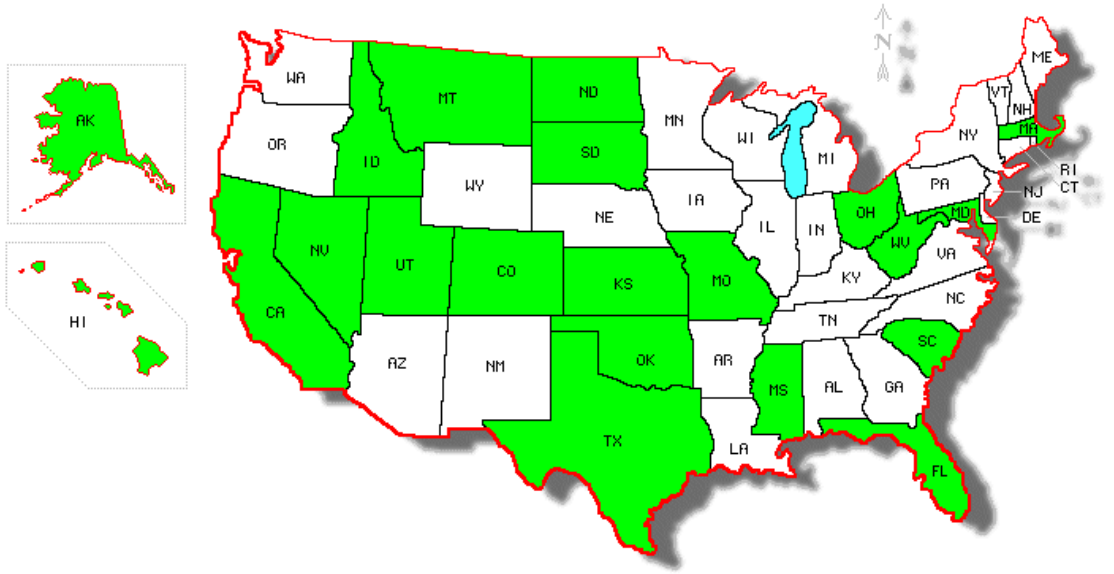
Remote Practice

Figure 5: Noneconomic damages caps

2001



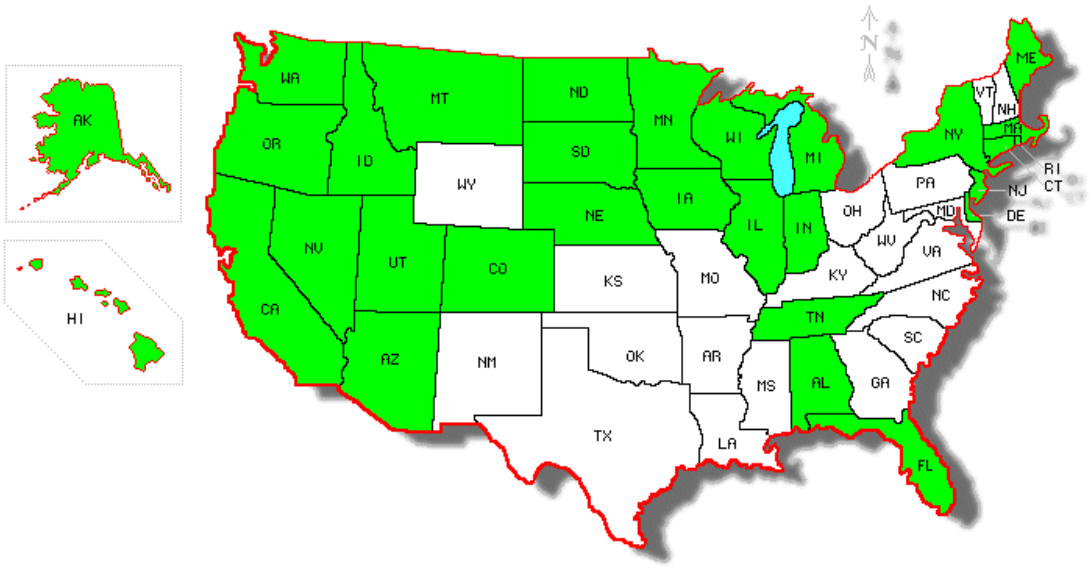
2013



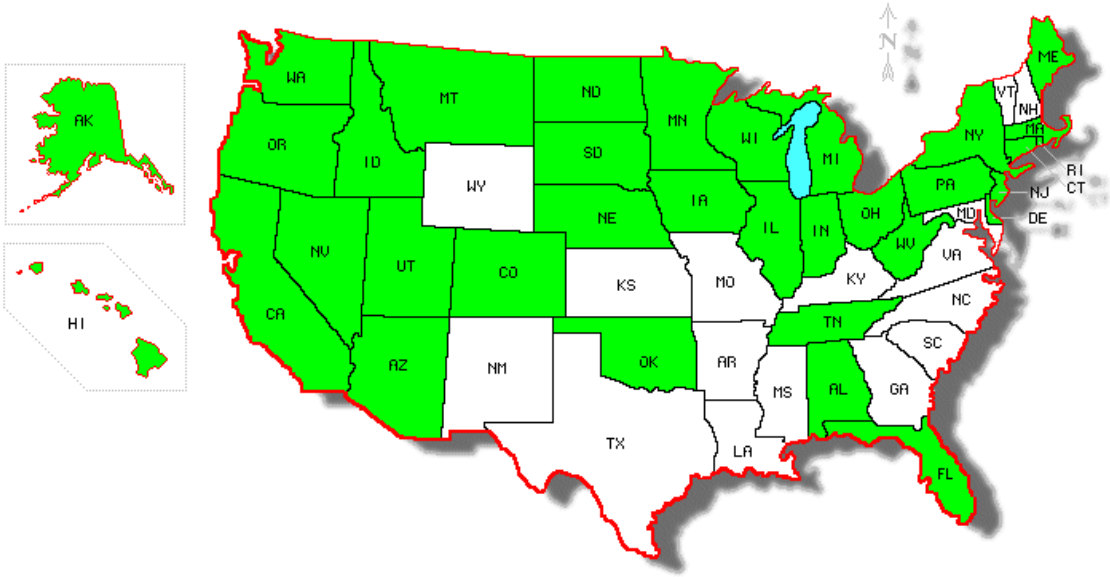
Noneconomic Damages Cap

Figure 6: Collateral source rule reform

2001



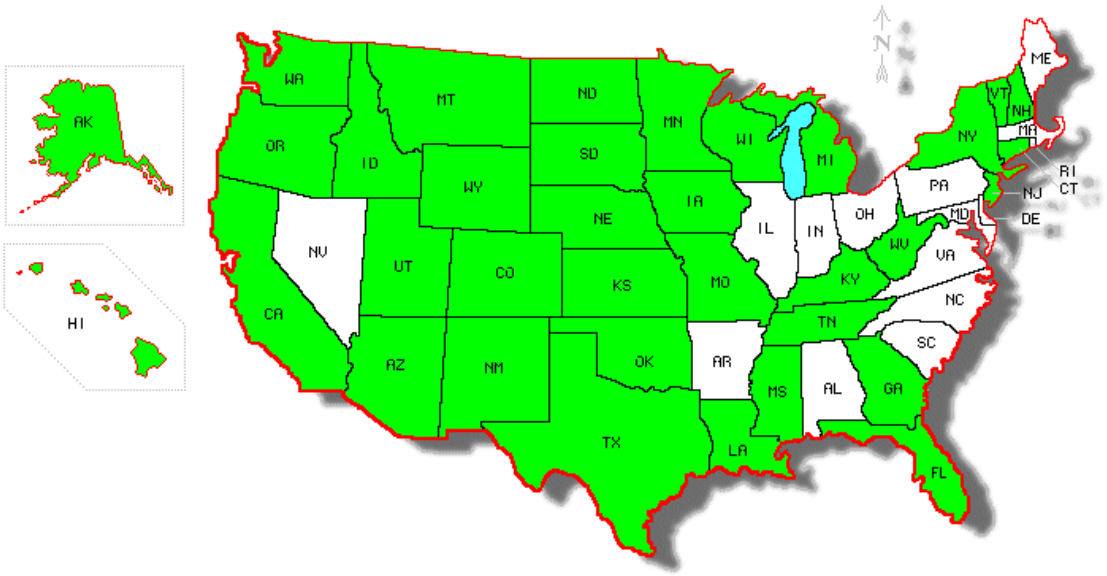
2013



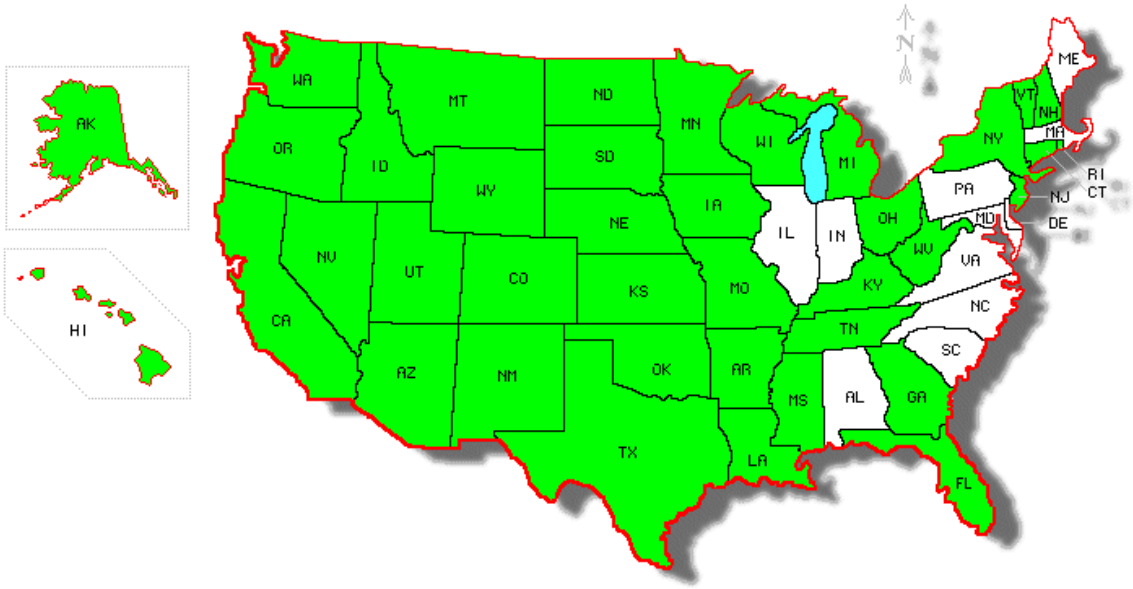
Collateral Source Rule Reform

Figure 7: Joint and several liability rule reform

2001



2013



Joint and Several Liability Reform

Table 1: Summary Statistics for the Distribution of Nurse Practitioners

	(1) Mean	(2) Std. Dev.
Total NPs	30.33	28.16
Independence	33.97	30.00
MD RX Supervision only	27.50	25.14
Complete Supervision	30.11	28.30
Full Controlled Substances Authority	35.13	32.60
Limited Controlled Substances Authority	26.07	22.70
Noneconomic Cap	31.23	28.14
No Cap	29.76	28.15
Collateral Source Reform	30.27	27.34
No Collateral Source Rule Reform	30.40	29.13
Joint and Several Liability Reform	30.51	26.93
No Joint and Several Liability Reform	29.66	32.27

Notes: Each mean represents the mean number of NPs per 100,000 county residents. Each grouping of legal variables consists of mutually exclusive categories. The difference between the mean number of NPs per capita for any set of licensing law regimes is statistically significant. The difference between the mean number of NPs per capita in jurisdictions with noneconomic damages caps and those without caps is statistically significant.

Table 2: Summary Statistics for the Distribution of Physician Assistants

	(1) Mean	(2) Std. Dev.
Total PAs	20.77	28.04
Remote Practice	24.22	30.04
Restricted Practice	13.41	21.40
Full Controlled Substances Authority	26.61	28.28
Limited Controlled Substances Authority	16.30	27.01
Noneconomic Cap	22.74	27.48
No Cap	19.54	28.31
Collateral Source Reform	24.62	30.70
No Collateral Source Rule Reform	16.08	23.56
Joint and Several Liability Reform	21.28	25.16
No Joint and Several Liability Reform	18.88	36.70

Notes: Each mean represents the mean number of PAs per 100,000 county residents. Each grouping of legal variables consists of mutually exclusive categories. The differences in the mean number of PAs per capita across all licensing and liability regimes are statistically significant.

Table 3: Predicted Effects of Licensing and Liability Laws Based on Simple Model

Panel A: NPs	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Complete Supervision	baseline	+	+	ambiguous[1]	+
MD RX supervision only	+	+	+	ambiguous[1]	+
Independence	+	+	+	ambiguous[1]	+
Limited Controlled Substances Authority	baseline			ambiguous[1]	+
Full Controlled Substances Authority	+	+	+	ambiguous[1]	+

Panel A: PAs	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Onsite Supervision	baseline	+	+	ambiguous[1]	+
Remote Practice	+	+	+	ambiguous[1]	+
Limited Controlled Substances Authority	baseline	+	+	ambiguous[1]	+
Full Controlled Substances Authority	+	+	+	ambiguous[1]	+

Notes: Each cell reports the predicted direction of the net effect of the licensing law on the left and the tort reform listed above. These predictions assume that NPs and PAs cannot induce demand and that physician preferences and behavior toward NPs and PAs do not vary with licensing and liability laws.
[1]The effect of joint and several liability reform is theoretically ambiguous since it may increase or decrease the expected liability costs of providers. An ambiguous result for joint and several liability reform implies an ambiguous result for all reforms, but I assume, for the purposes of this table, that the effect of joint and several liability reform does not outweigh the effects of other reforms.
CSR = collateral source rule reform
JSLR = joint and several liability reform

Table 4: Regression Results for Nurse Practitioner Laws

	(1)	(2)
Independence from MD	-0.083	0.474*
	(0.089)	(0.251)
MD RX supervision only	0.048	-0.093
	(0.085)	(0.125)
Controlled Substances Authority	-0.124	-0.226
	(0.123)	(0.218)
Noneconomic damages cap	0.034	0.198
	(0.105)	(0.183)
Collateral source rule reform	0.239**	0.178**
	(0.113)	(0.068)
Joint and several reform	0.055	-0.155
	(0.105)	(0.184)
(Independence)x(Nonecon cap)		-0.511*
		(0.263)
(Independence)x(CSR)		0.973***
		(0.203)
(Independence)x(JSLR)		-0.809***
		(0.262)
(RX supervision)x(Nonecon cap)		0.031
		(0.149)
(RX supervision)x(CSR)		-0.019
		(0.138)
(RX supervision)x(JSLR)		0.344**
		(0.132)
(Controlled Substances)x(Nonecon cap)		-0.404*
		(0.217)
(Controlled Substances)x(CSR)		0.088
		(0.225)
(Controlled Substances)x(JSLR)		0.296
		(0.299)
log(MDs office per 100K)	0.131***	0.131***
	(0.019)	(0.018)
log(MDs hospital per 100K)	0.099***	0.099***
	(0.008)	(0.008)
Percent Medicare eligible	0.010***	0.010***
	(0.002)	(0.002)
Health insurance percent	0.002	0.003
	(0.003)	(0.003)
Urban influence	0.011**	0.011**

	(0.005)	(0.005)
Population density	0.015	0.015
	(0.016)	(0.016)
Rural	0.328***	0.328***
	(0.041)	(0.041)
Semi-rural	0.065**	0.065**
	(0.031)	(0.031)
Median household income (1000s)	-0.009***	-0.009***
	(0.001)	(0.002)
State fixed effects	yes	yes
Year fixed effects	yes	yes
Observations	14,075	14,075
R-squared	0.335	0.339

Notes: The dependent variable in all specifications is the natural logarithm of the number of NPs per 100,000 county residents. Counties with no practicing NPs are excluded. All specifications include state and year fixed effects. Standard errors clustered by state are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.
CSR = collateral source rule reform
JSLR = joint and several liability reform

Table 5: Regression Results for Physician Assistant Laws

	(1)	(2)
Remote Practice	-0.044	-0.234*
	(0.072)	(0.126)
Controlled Substances Authority	-0.005	0.203***
	(0.044)	(0.043)
Noneconomic damages cap	-0.123***	-0.094*
	(0.040)	(0.056)
Collateral source rule reform	0.088*	0.081
	(0.046)	(0.057)
Joint and several reform	-0.033	-0.038
	(0.037)	(0.040)
(Remote practice)x(Nonecon cap)		0.002
		(0.134)
(Remote practice)x(CSR)		0.142
		(0.132)
(Remote practice)x(JSLR)		0.121
		(0.131)
(Controlled Substances)x(Nonecon cap)		-0.074
		(0.094)
(Controlled Substances)x(CSR)		-0.158
		(0.114)
(Controlled Substances)x(JSLR)		-0.078
		(0.123)
log(MDs office per 100K)	0.084***	0.084***
	(0.021)	(0.021)
log(MDs hospital per 100K)	0.084***	0.084***
	(0.010)	(0.010)
Percent Medicare eligible	0.003	0.003
	(0.004)	(0.004)
Health insurance percent	-0.003	-0.003
	(0.003)	(0.003)
Urban influence	0.007	0.006
	(0.007)	(0.007)
Population density	0.023*	0.023*
	(0.013)	(0.013)
Rural	0.446***	0.447***
	(0.060)	(0.060)
Semi-rural	0.042	0.042
	(0.037)	(0.037)
Median household income (1000s)	-0.005**	-0.005***

	(0.002)	(0.002)
State fixed effects	yes	yes
Year fixed effects	yes	yes
Observations	12,381	12,381
R-squared	0.399	0.400

Notes: The dependent variable in all specifications is the natural logarithm of the number of PAs per 100,000 county residents. Counties with no practicing PAs are excluded. All specifications include state and year fixed effects. Standard errors clustered at the state level are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.
CSR = collateral source rule reform
JSLR = joint and several liability reform

Table 6: Estimated Effects of Licensing and Liability Laws

Panel A: NPs	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Complete Supervision	baseline	0	19%	0	19%
MD RX supervision only	0	0	19%	41%	60%
Independence	61%	21%	240%	6%	145%
Limited Controlled Substances Authority	baseline	0	19%	0	19%
Full Controlled Substances Authority	0	-33%	19%	0	-14%

Panel B: PAs	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Onsite Supervision	baseline	-9%	0	0	-9%
Remote Practice	-21%[1]	-30%	-21%[1]	-21%[1]	-30%
Limited Controlled Substances Authority	baseline	-9%	0	0	-9%
Full Controlled Substances Authority	23%	14%	23%	23%	14%

Notes: Each cell reports the net effect of the licensing law on the left and the tort reform above. Effects in Panel A are calculated from column (2) of table 4, and effects in Panel B are calculated from column (2) of table 5. All effects are calculated using the transformation provided by Halvorsen and Palmquist (1980) and are calculated only from coefficient estimates that are statistically significant.
[1]This effect is statistically significant as reported in table 5; however, as discussed in the text, there are good reasons to believe that this result is not robust.
CSR = collateral source rule reform
JSLR = joint and several liability reform

Table 7: Regression Results for Nurse Practitioner Laws with Physician Interaction by Physician Setting

	(1) Main Effect	(2) MD Office Interaction	(3) MD Hospital Interaction
log(MDs office per 100K)	0.217***		
	(0.024)		
log(MDs hospital per 100K)	0.090***		
	(0.029)		
Independence from MD	0.872***	-0.073*	-0.026
	(0.316)	(0.039)	(0.018)
MD RX supervision only	0.147	-0.052	0.003
	(0.168)	(0.037)	(0.014)
Controlled Substances Authority	-0.093	-0.020	-0.021
	(0.259)	(0.025)	(0.020)
Noneconomic damages cap	0.456**	-0.058**	-0.004
	(0.206)	(0.028)	(0.015)
Collateral source rule reform	0.055	0.023	0.010
	(0.164)	(0.034)	(0.020)
Joint and several reform	0.005	-0.045	0.017
	(0.237)	(0.034)	(0.030)
(Independence)x(Nonecon cap)	-0.457*		
	(0.256)		
(Independence)x(CSR)	0.771***		
	(0.198)		
(Independence)x(JSLR)	-0.721***		
	(0.253)		
(RX supervision)x(Nonecon cap)	0.051		
	(0.164)		
(RX supervision)x(CSR)	-0.052		
	(0.139)		
(RX supervision)x(JSLR)	0.320**		
	(0.132)		
(Controlled Substances)x(Nonecon cap)	-0.420*		
	(0.213)		
(Controlled Substances)x(CSR)	0.093		
	(0.221)		
(Controlled Substances)x(JSLR)	0.286		
	(0.300)		

Notes: The dependent variable is the natural logarithm of the number of NPs per 100,000 county residents. The regression includes state and year fixed effects and the same covariates reported in earlier tables. Column (1) reports the main effect of a variable, and the remainder of columns report the interaction between the variable listed on the left and the supply of the type of physician listed at the top of the column. Counties with no practicing NPs are excluded. Standard errors clustered at the state level are reported in parentheses. N = 14,075. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.
CSR = collateral source rule reform
JSLR = joint and several liability reform

Table 8: Regression Results for Physician Assistant Laws with Physician Interaction by Physician Setting

	(1) Main Effect	(2) MD Office Interaction	(3) MD Hospital Interaction
log(MDs office per 100K)	0.161***		
	(0.035)		
log(MDs hospital per 100K)	0.139***		
	(0.029)		
Remote Practice	-0.340	0.020	0.019
	(0.255)	(0.045)	(0.018)
Controlled Substances Authority	0.391**	-0.029	-0.021
	(0.175)	(0.038)	(0.023)
Noneconomic damages cap	0.228	-0.058*	-0.043**
	(0.142)	(0.032)	(0.018)
Collateral source rule reform	-0.000	0.033	-0.026
	(0.179)	(0.040)	(0.021)
Joint and several reform	0.385*	-0.077	-0.033
	(0.223)	(0.047)	(0.031)
(Remote practice)x(Nonecon cap)	-0.042		
	(0.123)		
(Remote practice)x(CSR)	0.217*		
	(0.117)		
(Remote practice)x(JSLR)	0.110		
	(0.149)		
(Controlled Substances)x(Nonecon cap)	-0.040		
	(0.085)		
(Controlled Substances)x(CSR)	-0.168		
	(0.115)		
(Controlled Substances)x(JSLR)	-0.110		
	(0.121)		

Notes: The dependent variable is the natural logarithm of the number of PAs per 100,000 county residents. The regression includes state and year fixed effects and the same covariates reported in earlier tables. Column (1) reports the main effect of a variable, and the remainder of columns report the interaction between the variable listed on the left and the supply of the type of physician listed at the top of the column. Counties with no practicing NPs are excluded. Standard errors clustered at the state level are reported in parentheses. N = 14,075. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.
CSR = collateral source rule reform
JSLR = joint and several liability reform

Table 9: Border County Regression Results for Nurse Practitioner Laws

	(1)	(2)
Independence from MD	0.014	-0.492**
	(0.082)	(0.233)
MD RX supervision only	0.083	-0.105
	(0.153)	(0.281)
Controlled Substances Authority	-0.048	-0.393***
	(0.127)	(0.143)
Noneconomic damages cap	-0.051	-0.093
	(0.115)	(0.166)
Collateral source rule reform	0.152	0.095
	(0.106)	(0.114)
Joint and several reform	-0.098	-0.222
	(0.134)	(0.161)
(Independence)x(Nonecon cap)		0.130
		(0.236)
(Independence)x(CSR)		0.088
		(0.289)
(Independence)x(JSLR)		0.400
		(0.294)
(RX supervision)x(Nonecon cap)		-0.121
		(0.278)
(RX supervision)x(CSR)		-0.019
		(0.234)
(RX supervision)x(JSLR)		0.306
		(0.285)
(Controlled Substances)x(Nonecon cap)		0.229
		(0.199)
(Controlled Substances)x(CSR)		0.048
		(0.159)
(Controlled Substances)x(JSLR)		0.449**
		(0.195)

Notes: The dependent variable in all specifications is the natural logarithm of the number of NPs per 100,000 county residents. Each specification also includes state and year fixed effects and the same covariates reported in earlier tables. Only counties that border another state are included, and counties with no practicing NPs are excluded. Licensing and liability laws are those of the neighboring state. Standard errors clustered at the state level are reported in parentheses. N = 4,095. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.
CSR = collateral source rule reform
JSLR = joint and several liability reform

Table 10: Border County Regression Results for Physician Assistant Laws

	(1)	(2)
Remote Practice	-0.486***	-0.325**
	(0.105)	(0.138)
Controlled Substances Authority	0.157	0.150
	(0.138)	(0.187)
Noneconomic damages cap	0.153*	0.163
	(0.086)	(0.124)
Collateral source rule reform	0.161	0.298**
	(0.141)	(0.148)
Joint and several reform	0.069	0.098
	(0.129)	(0.133)
(Remote practice)x(Nonecon cap)		0.121
		(0.225)
(Remote practice)x(CSR)		0.167
		(0.203)
(Remote practice)x(JSLR)		-0.311
		(0.216)
(Controlled Substances)x(Nonecon cap)		-0.163
		(0.247)
(Controlled Substances)x(CSR)		-0.535***
		(0.179)
(Controlled Substances)x(JSLR)		0.365
		(0.268)

Notes: The dependent variable in all specifications is the natural logarithm of the number of PAs per 100,000 county residents. Each specification also includes state and year fixed effects and the same covariates reported in earlier tables. Only counties that border another state are included, and counties with no practicing PAs are excluded. Licensing and liability laws are those of the neighboring state. Standard errors clustered at the state level are reported in parentheses. N = 3,626. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.
CSR = collateral source rule reform
JSLR = joint and several liability reform

CHAPTER 3

THE EFFECT OF LICENSING AND LIABILITY LAWS ON HEALTHCARE QUALITY: EVIDENCE FROM CANCER SCREENINGS

I. Introduction

While much of the recent debate over ensuring the quality of healthcare has occurred at the federal level in the context of the Affordable Care Act (ACA), the majority of regulation designed to promote healthcare quality in the United States occurs at the state level. In particular, states are the most important regulators of the healthcare workforce, which is responsible for delivering safe and effective healthcare. State occupational licensing laws determine who may join the healthcare workforce and how they may operate within it. State tort law allows individual patients to hold members of the healthcare workforce accountable for their mistakes, which (in theory) deters those mistakes in the first place.

Historically, physicians were primarily responsible for the care of patients. However, since the 1960s, nurse practitioners (NPs) and physician assistants (PAs) have supplemented and, in some cases, supplanted the care traditionally provided by physicians. These two professions practice in many of the same settings as physicians, and about half of all NPs and PAs practice in primary care settings. They currently outnumber family and general practice physicians and will soon outnumber all primary care physicians (Stange 2014; Traczynski and Udalova 2014). However, unlike physicians, NPs and PAs face substantial variation in the state occupational licensing laws that govern how they provide care to patients. States differ on the degree of

physician supervision required for NPs and PAs to practice as well as on the specific healthcare services they may provide.

Occupational licensing laws ostensibly ensure quality by preventing unqualified professionals from providing healthcare. However, if these laws restrict the capacity of competent healthcare professionals to provide care, they may actually undermine the quality of care received by the public. In 2011, the Institute of Medicine (IOM) called for NPs to practice to the full extent of their training and explained that a "variety of historical, regulatory, and policy barriers have limited nurses' ability to generate widespread transformation" in the healthcare system (IOM 2011). In 2014, the Federal Trade Commission (FTC) issued a report explaining that healthcare quality itself can be a locus of competition and that by restricting the practices of NPs, state occupational licensing laws could adversely affect quality (Gillman and Koslov 2014).

While occupational licensing laws can have a substantial impact on the provision of healthcare, they are not the only state legal regime that affects how the healthcare workforce provides care. When a healthcare provider injures a patient, that patient may sue the provider for malpractice under state tort law. In theory, legal liability can force providers to internalize the costs of their mistakes and take appropriate care to avoid them. However, if liability is not appropriately calibrated, it can over-deter or under-deter individual providers, which can distort the incentives to provide quality healthcare. The American Medical Association, among others, asserts that medical malpractice liability over-deters physicians, causing them to perform unnecessary tests and procedures as well as avoid certain high-risk patients (often referred to as defensive medicine). In response to perceived problems in their tort regimes, many states have enacted tort reforms to decrease the risks associated with legal liability.

Occupational licensing laws complicate the effect of tort reforms and liability generally on NPs and PAs because patients injured by an NP or PA often have the option of suing both the NP/PA and the supervising physician for medical malpractice either directly or under a theory of vicarious liability. All states require that physicians supervise PAs to some degree, and almost all states have statutes or regulations that require physicians to accept medical and legal responsibility for the actions of PAs they supervise. In order to sue a physician for the medical negligence of an NP, state statutes and case law generally require that the physician be involved with the patient in some way (Buppert 2012), and state occupational licensing laws will affect the extent to which physicians involve themselves with the patients of NPs. The ability of plaintiffs to sue physicians involved in the practices of NPs and PAs implies that NPs and PAs receive protection from liability, to some degree, from state occupational licensing laws in addition to any protection received from state tort reforms. This decrease in liability exposure in certain licensing regimes also implies that the legal system may not be able to force NPs and PAs to fully internalize the costs of their medical errors.

While previous work in the economic, law, and medical literatures has evaluated the effect tort reforms have on the quality of care, those studies have focused almost exclusively on care provided by physicians and (to a lesser extent) hospitals. No study has yet examined how malpractice liability and tort reforms affect the care provided by NPs and PAs. Additionally, while clinical studies have evaluated the quality of care provided by NPs, PAs, and physicians, no work has evaluated how healthcare quality varies across state licensing laws using objective measures of quality. Traczynski and Udalova (2014) consider self-reported (by patients) measures of healthcare quality, but their work does not consider objective measures, include the effects of tort reforms, or include PAs.

In this chapter, I provide the first evaluation of tort reforms and occupational licensing laws on the quality of care delivered across the country. As a measure of quality, I consider three types of related cancer screenings. Because the US Preventative Task Force (USPTF) and American Cancer Society (ACS) publish explicit guidelines for when individuals should receive different cancer screenings, whether individuals have received the medically appropriate screening and whether they have received a medically inappropriate screening provide objective measures of healthcare quality. Cancer screenings are useful for examining the effect of licensing and liability laws on healthcare quality for three reasons. First, missed cancer diagnoses are one of the most common claims for medical malpractice, so cancer screenings will be sensitive to changes in the risk of malpractice liability (Schiff et al. 2013). Second, NPs and PAs are routinely responsible for ordering cancer screenings, so screenings will be sensitive to changes in NP and PA authority. Finally, cancer screenings are often ordered and conducted by primary care providers. Because over half of all practicing NPs and almost half of all practicing PAs work in primary care, changes in both NP/PA supply and behavior in response to legal changes will affect how the population is screened for cancer.

I find that decreasing the physician supervision requirements for NPs and PAs generally increases the rate of both medically appropriate and medically inappropriate cancer screenings. I also find evidence that increasing the prescriptive authority of NPs increases the rate of appropriate screenings. In general, tort reforms do not have a substantial effect on cancer screening rates. However, I find that when joint and several liability reform, which has complex effects on the incentives of healthcare providers, has been passed, increasing the breadth of NP and PA licenses reduces both appropriate and inappropriate cancer screening rates. These results have three important implications for licensing and liability laws.

First, the different effect of broader NP and PA licensing laws across different tort regimes is consistent with changes in the practice patterns of these providers when their broader licenses expose them to the incentives created by malpractice liability and tort reforms. Second, the evidence does not suggest that licensing or liability laws improve or harm healthcare quality as measured by cancer screening rates. Because licensing laws increase both appropriate and inappropriate cancer screenings in the absence of joint and several liability reform and decrease both types of screenings when joint and several liability reform has been passed, the results are not consist with an improvement in quality. Instead, the results suggest that consumption of healthcare services increases or decreases, without respect to whether those services are medically indicated, in response to changes in licensing and liability laws.

Third, the estimated increases in the use of both appropriate and inappropriate cancer screenings in response to broader NP and PA authority are comparable to the effects of insurance mandates requiring coverage of cancer screenings (see Bitler and Carpenter 2014). This suggests some substitutability between regulations targeting the demand side of healthcare markets (i.e., insurance providers) and regulations focusing on the supply side of healthcare markets (i.e., the healthcare workforce). The next section provides relevant background information on NPs and PAs, licensing laws, tort reforms, and cancer screenings.

II. Background and Literature

A. The Licensing and Liability Laws Governing NPs and PAs

NPs and PAs emerged as separate professions in the 1960s. Currently, most new NPs and PAs require graduate-level training in the provision of healthcare services. NPs usually complete one to two years of education beyond that required of registered nurses with bachelor degrees in

nursing. PAs complete between 18 months and three years of training, and most training programs require previous experience in healthcare prior to admission. Clinical evidence has consistently demonstrated that NPs and PAs are as competent as physicians within the scope of their education and training (Newhouse et al. 2011; Naylor and Kurtzman 2010). NPs and PAs differ from one another in their training with NPs being trained in the nursing model and PAs being trained in the medical model of care. When providing care, NPs often focus on the health and well-being of the whole person while PAs tend to focus more specifically on the treatment of diseases and injuries. A greater proportion of NPs and PAs than physicians work in primary care settings. About 50% of NPs and 45% of PAs practice in primary care, and they already outnumber family and general practice physicians. With their growth in primary care outpacing that of physicians, NPs and PAs will soon outnumber all primary care physicians (Stange 2014).

Unlike physicians, NPs and PAs face substantially different occupational licensing laws depending on the state in which they practice. In theory, occupational licensing laws exist to protect the public from low quality (and harmful) healthcare by requiring that healthcare professionals meet minimum training requirements and competency standards. However, when occupational licensing laws become overly restrictive or are used by one professional group to insulate itself from competition from other groups, these laws can increase the price of, decrease access to, and adversely affect the quality of healthcare (Kleiner 2006; Kleiner et al. 2014).

While occupational licensing laws govern almost every aspect of the practices of NPs and PAs, two specific types of laws have the greatest impact on these providers. Physician supervision laws determine to what extent a physician must supervise the practice of an NP or PA, and scope of practice laws determine what services NPs and PAs may provide. I group NP supervision laws into two separate categories: those allowing NPs to practice independently of

physicians and those requiring some form of physician supervision of NP practices. While no state allows PAs to practice without any physician oversight, I classify states by whether they allow PAs to consistently practice at geographically separate sites from their supervising physicians. States allowing remote PA practice allow PAs to practice at a site away from their supervising physician while requiring the physician to visit the PA monthly or less frequently. I classify states requiring more frequent physician visits to the PA's practice site and states requiring that the PA practice only on the same premises as the physician as having an onsite supervision requirement.

Scope of practice laws govern what services NPs and PAs may provide generally, but among these laws, those governing the authority of NPs and PAs to prescribe medications are generally the most important. States granting NPs and PAs full controlled substances authority allow them to prescribe essentially the same range of medications and controlled substances as physicians.[48] States granting NPs and PAs limited controlled substances authority restrict their ability to prescribe controlled substances to a greater degree than physicians.[49] Within all possible scope of practice laws, I focus on the prescriptive authority of NPs and PAs for three reasons. First, writing prescriptions forms an integral part of the practices of most NPs and PAs, so it represents the most important division among state scope of practice laws. Second, it is possible to cleanly divide state prescriptive authority laws because they prohibit or allow NPs and PAs to prescribe specifically listed drugs. Finally, increased prescriptive authority may lead to separation in the day-to-day practices of physicians, NPs, and PAs, regardless of state

[48] Controlled substances are a subset of drugs that are more heavily regulated by the Food and Drug Administration and the Drug Enforcement Agency than over-the-counter medications or non-controlled prescription drugs. Controlled substances are classified into one of five schedules. Schedule I drugs have no accepted medical use, are dangerous to use, and are illegal to use, possess, or manufacture. Schedule II drugs have a high potential for abuse and severe side effects but have accepted medical uses. Drugs on schedules III through V decrease in risk as their schedule decreases.

[49] These restrictions generally apply to schedule II and III controlled substances.

supervision laws. This separation in the day-to-day practices can expose NPs and PAs to more liability since patients will find it more difficult to hold the physician liable when she was not directly involved with the patient.

It is important to note that licensing laws for NPs and PAs are determined separately and that within each profession, physician supervision requirements and scope of practice laws are determined independently. For example, a state allowing NPs to practice independently implies neither that NPs possess full controlled substances authority nor that PAs may practice remotely. Similarly, a state granting PAs full controlled substances authority implies neither that NPs possess this authority nor that PAs may practice remotely.

Prior research on the occupational licensing laws governing NPs and PAs has focused primarily on the effects of those laws on the labor markets for NPs, PAs, and physicians and on healthcare services markets (see, e.g., Dueker et al. 2005; Perry 2009). Stange (2014) and Kleiner et al. (2014) provide the most comprehensive evaluations of the effects of NPs and PAs on healthcare services markets. Stange (2014) focuses on the effects of NP and PA supply and finds that changes in supply have little effect on the office-based healthcare market. His primary measure of NP and PA licensing laws is a time-invariant index of laws, and he finds that when laws are more favorable to NPs and PAs, healthcare utilization is more sensitive to changes in NP and PA supply. Kleiner et al. (2014) focus on NP licensing laws and find that broader licensing laws decrease the price of a common medical examination, consistent with the FTC's report that NP licensing laws restrict competition and raise prices (Gillman and Koslov 2014).

Traczynski and Udalova (2014) present some of the first evidence of the effect of NP licensing laws on healthcare outcomes (they do not consider PAs). Their measures of healthcare quality and utilization are self-reported measures of office-visit quality, whether individuals have

had a routine checkup within the last year, and whether individuals could obtain a healthcare appointment when desired. They also consider individuals' body mass indexes, self-reported health status, and emergency room usage. In general, they find broader NP licensing laws improve their measures of health outcomes and healthcare quality.

In this chapter, I extend the work of Traczynski and Udalova (2014) by considering objective measures of healthcare quality. I also include PA licensing laws in my analysis as well as tort reforms since NPs and PAs likely react to legal liability similarly to physicians. While Traczynksi and Udalova (2014) and Stange (2014) analyze data from 1984 through 2011 and 1990 through 2008, respectively, I limit my analysis to 1998 through 2012. Prior to 1998, Medicare, along with most state Medicaid programs and private insurance companies, would not reimburse NPs and PAs unless they were providing services "incident to" physician services. Therefore, although some states allowed NPs and PAs to function with less supervision prior to 1998, these laws represented legal realities more than practical realities since NPs and PAs functioning away from physicians could not generally obtain reimbursement.[50] After the passage of the Balanced Budget Act of 1997, Medicare began reimbursing NPs and PAs directly for services not "incident to" physician services (although at 85% of the physician rate). State Medicaid programs and private insurers generally followed suit.

B. Medical Malpractice and Tort Reform

When an NP or PA negligently harms a patient, the patient may sue the NP or PA for malpractice. When a plaintiff sues a PA, she will likely also be able to sue the PA's supervising physician because most state laws require the physician to accept legal and medical

[50] Some exceptions existed so that NPs and PAs providing care to certain populations could receive direct reimbursement, and some insurance carriers did reimburse NPs and PAs prior to 1998.

responsibility for the PA's practice. Of course, this does not relieve the PA of legal responsibility, but it may reduce the amount of damages the PA can expect to pay or reduce the probability that the PA must pay at all if the physician makes the full payment.

When a plaintiff sues an NP, she will not have the option of suing a supervising physician if state law allows the NP to practice independently. States requiring physician supervision of NPs typically do not require the physician to accept the same level of responsibility for the mistakes of NPs as they must for PAs. In fact, current state laws almost always require the physician to have been involved with a given patient in some way in order for the patient to hold the physician liable (Buppert 2012). This implies that when the practices of NPs and physicians are separate on a day-to-day basis, plaintiffs may find it more difficult to hold the physician liable for the mistakes of the NP. If, as discussed above, granting NPs full controlled substances authority allows them to separate their practices from their supervising physicians, then this authority may have similar malpractice implications as laws removing supervision requirements.

In theory, tort law can efficiently deter the provision of low quality or harmful care by forcing providers to internalize the costs of the harms they negligently inflict on others. By imposing legal damages on healthcare providers, courts can incentivize those providers to take appropriate caution when providing care. However, the deterrence value of tort law requires that it impose appropriately calibrated damages only on providers who failed to take appropriate caution when providing care. If courts impose damages on innocent providers, fail to impose damages on negligent providers, or impose damages inconsistent with the harm inflicted, tort law will not efficiently deter the provision of low quality care.

Tort reforms are state statutes that alter traditional tort law. Throughout my analysis, I focus on what the malpractice literature has deemed the three major reforms (see Avraham and

Schanzenbach 2010). First, noneconomic damages caps prohibit the imposition of noneconomic damages, which compensate plaintiffs for difficult-to-quantify injuries like pain and suffering, above a certain amount. The threshold amount differs across states, so I use Avraham's (2011) "clever" definition of noneconomic damages caps. These caps have been set low enough and contain few enough exceptions to effectively limit the amount of noneconomic damages awarded by courts.

Second, collateral source rule reform allows defendants to introduce evidence that the plaintiff has received compensation for her injury from some other source (typically a health insurance policy) and allows the court to reduce the final damages award by the amount of other compensation the plaintiff received. Finally, joint and several liability reform alters the traditional rule of joint and several liability which allows plaintiffs to collect an entire damages award from any one of multiple defendants. With this reform in place, plaintiffs may collect damages from multiple defendants only in proportion to their liability.[51]

Prior work has found mixed evidence on the effect of tort reforms on the healthcare system. Kessler and McClellan (1996) find that tort reforms reduce medical costs associated with elderly cardiologic patients without any adverse effect on health outcomes. Kessler and McClellan (1996) aggregate a variety of tort reforms into "direct" and "indirect" categories. Later work has used different measures of malpractice pressure. Dubay et al. (1999) directly measure malpractice premiums and find that reducing malpractice pressure would increase the use of early prenatal care in pregnancy.

Currie and MacLeod (2008) also consider the effect of tort reform on obstetric care. They find that noneconomic damages caps and other reforms that directly reduce damages awards

[51] Many state laws include exceptions that allow plaintiffs to collect the full amount of damages from a single defendant if her proportion of liability exceeds a certain threshold (e.g., 50%).

increase treatment intensity and complications from labor and delivery while joint and several liability reform reduces both intensity and complications. Interestingly, in almost all of their results, the negative effect of joint and several liability reform is larger in magnitude than the positive effect of noneconomic damages caps. Beyond heart patients and births, Frakes (2013) considers the effect of tort reform on healthcare utilization. He finds no significant effect of remedy-centric tort reforms like noneconomic damages caps, but when states require courts to judge the negligence of physicians based on national standards of care, as opposed to local ones, healthcare utilization converges to the national mean with no effect on patient outcomes. Frakes and Jena (2014) extend this work by examining several measures of healthcare quality, including cancer screening rates. They find no significant effect of traditional tort reforms, but they find that implementing national standards of care improves quality.

I extend the new and growing literature on laws and healthcare quality. As Frakes and Jena (2014) note, tort law and the incentives it creates can affect healthcare quality; however, NPs and PAs, especially in their roles as primary care providers, have the potential to improve quality beyond the incentives created by tort law. Before describing the empirical strategy I use to estimate the effects of licensing and liability laws, the next section provides background information on cancer screenings.

C. Cancer Screenings

I consider three different types of cancer screenings: mammograms, clinical breast exams, and pap smears. These three screenings are correlated since all three target female-specific cancers. While the presence of specific screening guidelines and sufficient data facilitate the use of these three screenings as measures of healthcare quality, these screenings do not

capture the entire universe of cancer screenings. Mammograms and clinical breast exams both target breast cancer while pap smears target cervical cancer. Clinical breast exams involve visual examination and palpation of the breast tissue by healthcare providers to look for warning signs of breast cancer. Mammography involves placing a woman's breasts into a machine which takes X-ray pictures using low doses of radiation. A healthcare provider later interprets the test to determine if any signs of breast cancer are present. During a pap smear (or pap test), a healthcare provider collects cells from a woman's cervix. Those cells are then analyzed under a microscope to look for abnormalities that could indicate cervical cancer.

Breast cancer is the most commonly diagnosed cancer. Among women in the United States, it is the second leading cause of cancer deaths, killing around 40,000 women per year. Although recent studies have questioned the usefulness of breast cancer screenings and early diagnosis (see Gøtzsche and Jørgensen 2013; Saquib et al. 2015), early screening is generally understood to be one of the most important determinants of breast cancer survival (Bitler and Carpenter 2014). Cutler (2008) surveys the available evidence and concludes that cancer screenings are the most important factor behind declining cancer mortality rates since the 1970s. Berry et al. (2005) estimate that routine screenings account for between about 25% to over 50% of the decline in the rate of breast cancer deaths since 1975.

Different organizations generate different recommendations for cancer screenings. I define an "appropriate" cancer screening based on the guidelines issued by the USPTF and ACS.[52] Because healthcare providers may follow either set of guidelines, I define a medically appropriate screening based on the patient populations that fit within both sets of guidelines. Doing so also alleviates concerns about changing guidelines during my sample period of 1998

[52] The USPTF is a panel of expert primary care physicians and epidemiologists who are appointed by the US Department of Health and Human Services' Agency for Healthcare Research and Quality.

through 2012 since the final definitions of appropriate screenings I use have always included the relevant populations. I define an "inappropriate" cancer screening as one that falls outside the guidelines of both the USPTF and ACS. Table 1 presents an overview of the medically appropriate and medically inappropriate populations for each of the three screenings I consider. Women over 50 should receive a mammogram biennially. Similarly, women over 50 should receive a breast exam every two to three years.[53] Pap smears are medically appropriate for women between the ages of 21 and 64.

Prior work on cancer screenings has focused primarily on the demand side of the healthcare market. Bitler and Carpenter (2014) find that state insurance laws requiring coverage of mammograms increase screenings.[54] Studying the Oregon Health Insurance Experiment, Finkelstein et al. (2012) find that mammography rates increased significantly when Medicaid-eligible women were provided insurance to cover mammograms. In a similar study on the Massachusetts Health Reform, Kolstad and Kowalski (2010) find no increase in mammography rates in response to having this screening covered through insurance. As part of the RAND Health Insurance Experiment, Lurie et al. (1987) find no increase in pap smears among individuals assigned a plan in which pap smears were "free" versus individuals in cost-sharing plans.

My work supplements earlier work on cancer screenings by focusing on the supply side of healthcare markets—the healthcare workforce. If the healthcare workforce is inadequate or

[53] The USPTF has concluded that sufficient evidence is not available to make a recommendation about clinical breast exams. The ACS guidelines recommend a clinical breast exam every three years for women over 40. To be parallel with the UPSTF's mammogram recommendations, I define the medically appropriate population to be women over 50. I also consider whether individuals have had a clinical breast in the last two years to be parallel with mammograms since healthcare providers may substitute a clinical breast exam for patients unable or unwilling to complete a mammogram.

[54] The data period I consider overlaps very little with their data period, and few insurance law changes occurred during the period I study.

restricted from providing care, insurance benefits will not prove very useful. For example, even if a mammogram is free, if individuals do not know they would benefit from one because the healthcare workforce has not been able to educate them, insurance benefits are not very useful. The next section describes the data I use to evaluate the effects of licensing and liability laws on cancer screenings.

III. Data

The primary source of data for my analysis is the Behavioral Risk Factor Surveillance System (BRFSS), which is conducted annually under the aegis of the Centers for Disease Control and Prevention (CDC). The BRFSS consists of a telephone survey in which individuals answer questions about their health and the healthcare they have received in the past. Each year, the BRFSS includes a set of questions asked in every state, and individual states may include additional questions. Beginning in 2000, questions about mammograms, clinical breast exams, and pap smears were included every other year. Prior to that, they were asked every year. As noted above, the period I consider is 1998 through 2012.

In addition to information on cancer screenings, the BRFSS includes demographic information about each respondent including age, sex, race, employment status, and education level. The BRFSS also contains some general information about respondents' health such as body mass index and smoking habits. I augment the demographic information in the BRFSS with state-level information from the Area Health Resource File including the number of obstetric beds (as a proxy for the healthcare infrastructure available to women) and the rural status of respondents' counties.[55]

[55] The BRFSS includes respondents' counties over a certain size. I created an indicator variable for small counties that I cannot match to a specific rural/urban status.

Data on NP occupational licensing laws come from legislative updates published by *The Nurse Practitioner* and from several editions of *Physician Assistants: State Laws and Regulations*. I augment these secondary sources with direct statutory and regulatory searches using Westlaw and its associated products. Doing so allows me to code state laws consistently without relying solely on secondary sources, which may include inconsistent statutory interpretation. While prior work has coded occupational licensing laws differently, I focus on scope of practice laws (specifically, prescriptive authority) and physician supervision laws and use indicator variables for different laws. For NP supervision laws, I code states requiring no physician supervision of NP practices as allowing independent NP practice and states requiring any physician supervision or collaboration as requiring supervision. For PA supervision laws, I code states allowing PAs to practice at sites geographically distinct from their supervising physicians and requiring onsite visits no more than once per month as allowing remote PA practice. Otherwise, I code states as requiring onsite supervision of PAs. For prescriptive authority, I separate states based on whether they allow NPs to prescribe essentially the same range of medications as physicians (full controlled substances authority) or not (limited controlled substances authority). I do the same for PA prescriptive authority.

Data on state tort reforms come from Avraham's (2011) Database of State Tort Law Reforms. I gather information on collateral source rule reform and joint and several liability rule reform. Using the provided statutory citations, I extend Avraham's coding of state tort laws through 2012. I use Avraham's "clever" definition of noneconomic damages caps which are set low enough and contain few enough exceptions to effectively limit damages.

IV. Empirical Strategy and Expected Effects

The purpose of my empirical analysis is to test whether broader occupational licensing laws and tort reforms affect medically appropriate and medically inappropriate cancer screenings. Broader occupational licensing laws can affect whether individuals receive cancer screenings through two different mechanisms. First, they increase the supply of NPs and PAs, which can directly increase the capacity of the healthcare system to provide screenings. Second, by removing restrictions on NPs and PAs, broader occupational licensing laws allow those providers to better meet the demand for healthcare. Given the nature of the available data, I am not able to distinguish between these two effects, so the coefficient estimates reported below represent the joint effect of changes in provider supply and changes in provider behavior in response to changes in licensing laws similar to Traczynski and Udalova (2014) and Kleiner et al. (2014). In general, broader NP licensing laws may increase cancer screenings to a greater extent than broader PA licensing laws. Currently, there are more practicing NPs than PAs, and based on the differences in their training, with NPs tending to focus more on the whole person and promoting overall wellness and PAs focusing more specifically on disease diagnosis and treatment, NPs may promote cancer screenings more than PAs.[56]

Previous research has found that tort reforms do not generally affect cancer screening rates directly (see Frakes and Jena 2014). However, prior work has found that reforms that directly reduce expected damages payments, such as noneconomic damages caps and collateral source rule reform, may increase the use of more intensive procedures (see, e.g., Currie and MacLeod 2008). In my analysis, receiving a cancer screening is a more intensive procedure than not receiving one, so caps and collateral source rule reform may increase screenings.

[56] NPs may also be more likely to be a patient's primary care provider, responsible for the overall care of a given patient, while PAs may focus more on treating specific types of diseases and injuries and may not as often be directly responsible for managing a patient's overall care. Therefore, NP licensing laws may affect cancer screening rates to a greater extent than PA licensing laws.

Joint and several liability reform, on the other hand, may increase or decrease the use of more intensive procedures. Kornhauser and Klee (2007) and Kornhauser and Revesz (1989) show that joint and several liability reform has complicated effects on the ex ante incentive to take care. As this work demonstrates, it is not possible to determine the ex ante effect of joint and several liability reform on the damages a provider can expect to pay when multiple defendants may be held liable for a patient's injury. Thus, the incentives for healthcare providers to take care may increase or decrease with the passage of joint and several liability reform depending on the information available to them.

However, based on prior work which has found that joint and several liability reform often reduces the use of more intensive procedures, I expect that it will reduce the use of cancer screenings (see, e.g., Currie and MacLeod 2008; Kessler and McClellan 1996; Cano-Urbina and Montanera 2014). Additionally, joint and several liability general reduces the supply of NPs and, to a lesser extent, PAs, which should reduce the capacity of the healthcare system to provide screenings (see Chapter 2). In general, tort reforms affect the supply of NPs and PAs as well as the behavior of practicing providers. Again, because of the nature of the data, I cannot distinguish between these two effects similar to Avraham and Schanzenbach (2010), Currie and MacLeod (2008), and Kessler and McClellan (1996).

While both occupational licensing laws and tort reforms can affect cancer screenings, the effect of licensing laws is not necessarily consistent across all tort regimes. For example when an NP is supervised by a physician, she does not necessarily bear the full cost of her mistakes since the patient may sue the physician instead of or in addition to the NP. Because a supervised NP is protected from liability to an extent, the incentives created by tort law and tort reform are dampened relative to an independently practicing NP who bears the full costs of her mistakes.

Therefore, when NPs and PAs gain broader licenses, the effect of tort reforms should be magnified relative to their effect on NPs and PAs with narrower licenses.[57] The expected effects of different licensing and liability laws are summarized in table 2. Each cell reports the expected net effect of the licensing law on the left given the presence of the tort reform listed above.

To estimate the causal effect of licensing and liability laws on cancer screenings, I use a two-way fixed effects model, which is a generalization of the standard difference in differences approach. I estimate linear probability models using the following general specification:[58]

$$\begin{aligned} \mathrm{I}(screening)_{ist} = {} & licensing\ laws'_{st}\beta_1 + tort\ reform'_{st}\beta_2 + \\ & (licensing\ laws) \times (tort\ reform)'_{st}\beta_3 + \\ & W'_{ist}\theta + X'_{ist}\lambda + Z'_{st}\gamma + (state)_s \times (year)'_t + \\ & \delta_s + \tau_t + \varepsilon_{ist} \end{aligned} \tag{16}$$

In this specification, *I(screening)* is an indicator variable for whether individual, *i*, residing in state, *s*, at time, *t*, received a cancer screening. Depending on the specification, that screening may be a mammogram, clinical breast exam, or pap smear. I estimate separate models for appropriate and inappropriate screenings. For each screening, the indicator variable assumes the value one if the woman reported having that screening in the last two years. The vector *licensing laws* includes a series of indicators for both NP and PA licensing laws. In the preferred specification, both NP and PA licensing laws are included; although, I also estimate the model

[57] This magnification of effect should be most pronounced for independent NPs since patients lose the ability to sue a supervising physician. However, when NPs gain full prescriptive authority, their supervising physicians do not need to be as involved with their supervisee's practices which necessarily makes it more difficult to hold the physician liable. Although PAs always have supervising physicians, when PAs gain broader licenses, those physicians may be less involved in the practices of their PAs making it more difficult for patients to hold them liable. In general, physicians are less likely to be held liable for the mistakes of NPs and PAs when the latter possess broader licenses because plaintiffs essentially lose the ability to bring malpractice claims directly against the physician. Instead, they must rely on claims of vicarious liability, negligent supervision, or negligent hiring.

[58] Linear probability models may be preferable to probit and logit models because the latter two can lead to identification by functional form and suffer from the incidental parameters problem identified by Neyman and Scott (1948).

with NP and PA licensing laws separately. The vector *licensing laws* includes indicators for whether NPs may practice independently, whether NPs possess full controlled substances authority, whether PAs may practice remotely, and whether PAs possess full controlled substances authority. The vector tort reform includes indicators for the three major tort reforms: noneconomic damages caps, collateral source rule reform, and joint and several liability reform. Interactions between all licensing and liability laws are included in *(licensing laws)x(tort reform).*

W includes demographic controls such as indicators for different age groups, income levels, educations levels, and employment status.[59] *X* includes controls for personal characteristics such as race, body mass index, and smoking status, all of which are risk factors for cancer.[60] *Z* includes geographic control variables including whether a county is rural, whether a county's population is below the BRFSS's reporting range, and the number of obstetric beds in a state (which proxies for women's healthcare infrastructure). The vector *(state)x(year)* is a series of state-specific linear time trends, and I include state, δ, and year, τ, fixed effects. The inclusion of state and year fixed effects along with state-specific time trends mitigates concerns about omitted variable bias. All models are estimated using the sampling weights included with the BRFSS with standard errors clustered at the state level.

The key parameters of interest are β_1, β_2, and β_3, which represent the change in cancer screenings in response to different licensing and liability laws. Because both the dependent variable and independent variables of interest are indicators, each coefficient represents the

[59] The BRFSS data does not include continuous measures of age, income, or education. It provides information on these variables in ranges, and I include indicators for each of these ranges. For employment status, I include indicators for whether an individual is employed and whether they are self-employed.
[60] Because risk factors may be endogenous, I re-estimate all of the models reported below without this vector. None of the results change in any meaningful way.

percentage point change in the probability of having the relevant cancer screening associated with the relevant law.

Throughout my analysis, I treat licensing and liability laws as exogenous. Doing so is consistent with the existing literature on medical malpractice and tort reforms (see Avraham and Schanzenbach 2010). Additionally, while NP and PA licensing are driven by the political clout of different professional groups, there is no reason to believe that licensing laws are endogenously determined with cancer screenings. The political clout of healthcare professional groups is not dependent on cancer screenings, and they likely have little interest in these screenings as a way of increasing their profits. Additionally, state legislatures have demonstrated a propensity to deal with cancer screenings through insurance laws, not licensing laws (see Bitler and Carpenter 2014).

Table 3 reports summary statistics for each type of screening for the entire BRFSS sample as well as across different legal regimes. Each statistic represents the mean number of individuals in the medically appropriate population who have received the relevant screening. Almost 74% have had a mammogram in the last two years while nearly 71% and 75% have undergone a clinical breast exam and pap smear, respectively. The mean percentage of individuals receiving the two breast screenings does not differ substantially across NP supervision laws; although, more individuals in the medically appropriate population receive pap smears when NPs are supervised. However, a higher percentage of individuals receive medically appropriate cancer screenings of all types when NPs possess full controlled substances authority.

For PA occupational licensing laws, more women are screened for both cervical and breast cancer when PAs can practice remotely, and more people are screened for breast cancer when PAs can prescribe a full range of medications. Fewer people receive screenings in

jurisdictions with noneconomic damages caps and joint and several liability reform than in jurisdictions without these reforms. Fewer people receive pap smears when collateral source rule reform is in place, but more people receive clinical breast exams and mammograms. The next section details the results of my regression analysis to determine the effect of licensing and liability laws on screening rates.

V. Results and Discussion

A. Results for Medically Appropriate Cancer Screenings

Table 4 reports regression results from linear probability models with indicator variables for different cancer screenings as the dependent variables. All specifications include only the medically appropriate populations as defined in Table 1. Consistent with prior work, tort reforms have no general effect on cancer screenings; however, the one statistically significant effect of joint and several liability reform is consistent with prior work focusing on other health outcomes (see, e.g., Currie and MacLeod 2008).

Increasing the autonomy of NPs through both physician supervision laws and prescriptive authority laws increases the probability that a woman receives an appropriate cancer screening. Allowing NPs to practice independently increases the probability a woman receives either type of breast cancer screening by 4 percentage points and the probability a woman receives a pap smear by over 5 percentage points. Granting NPs full prescriptive authority increases the probability a woman receives a mammogram by almost 3 percentage points and the probability she receives a clinical breast exam by 2.5 percentage points.

The effects of increasing PA autonomy on cancer screenings are generally smaller and not statistically significant; however, allowing PAs to practice remotely increases the probability

a woman completes a mammogram by 4.6 percentage points. Collectively, these results imply that increasing the autonomy and authority of NPs and PAs increases consumption of medically appropriate services, consistent with the recommendations of the USPTF and ACS. In general, the size of the estimated effects is consistent with the size of the estimated effects of insurance mandates increasing the availability of breast cancer screenings (see Bitler and Carpenter 2014). This suggests that policies targeting the demand side of healthcare markets (insurance mandates) and the supply side (licensing laws) have similar effects.

Because table 4 reports multiple legal variables with interactions between them across three specifications with different dependent variables, tables 5 and 6 report the net effect of licensing laws across different tort regimes for NPs and PAs, respectively. Tables 5 and 6 each report the net effect of the licensing law on the left when the tort reform above has been enacted. Only the statistically significant coefficients from table 4 were used in calculating the net effects.

Table 5 reports the net effects of NP licensing laws across different tort regimes. Panel A reports net effects for mammograms while panels B and C report net effects for clinical breast exams and pap smears, respectively. Across all three panels, a similar pattern emerges. When NPs gain independence or full controlled substances authority in jurisdictions that have not enacted tort reforms or have enacted tort reforms that tend to reduce damages, like noneconomic damages caps and collateral source rule reform, cancer screenings increase. However, when NPs gain increased authority in jurisdictions with joint and several liability reform in place, cancer screenings tend to decrease.[61] This net decrease is consistent with NPs responding more strongly to tort reforms when they can practice independently or prescribe a full range of medications.

[61] However, this is not the case for clinical breast exams and pap smears when NPs gain full controlled substances authority with joint and several liability reform in place.

Although the theoretical effect of joint and several liability reform on the incentive to provide cancer screenings is not clear (see Kornhauser and Klee 2007), almost all previous research on the effect of tort reforms has estimated a negative effect of joint and several liability reform on procedure use (see, e.g., Kessler and McClellan 1996; Currie and MacLeod 2008). Therefore, a net decrease in the use of cancer screenings when NPs gain autonomy in the presence of joint and several liability reform is not surprising. This reform may increase the liability exposure of more autonomous NPs and allow plaintiffs to hold them liable for the mistakes other providers make in the course of breast cancer screenings, diagnosis, and treatment. For example, independently practicing NPs may see an increase in liability associated with the invasive, unpleasant, and unnecessary tests and procedures resulting from false positive screenings with joint and several liability reform in place.[62] This may discourage the use of cancer screenings generally. Alternatively, joint and several liability reform generally decreases the supply of NPs (see Chapter 2), which may limit the effect this profession can have on cancer screenings.

Table 6 reports the net effects of PA licensing laws across different tort regimes, and the panels are arrayed similarly to those in table 5. The most striking result from table 6 is that PA licensing laws generally affect cancer screenings less than NP licensing laws do. While PA licensing laws have a smaller effect on cancer screenings, the same pattern of effects is evident in PA licensing laws as NP licensing laws. Greater PA autonomy generally increases cancer screening rates when no tort reforms or only tort reforms that directly reduce expected damages are in place and decreases cancer screening rates when joint and several liability reform is in

[62] A false positive may include a true false positive in which cancer is detected when none exists. Alternatively, it may include detection of abnormalities which may or may not eventually result in cancer. These abnormalities sometimes invite intensive and unpleasant treatment with no improvement in mortality risk.

place. If PAs are more likely to be held liable for the errors of others when joint and several liability reform is in place, they may avoid screening individuals for cancer.

Overall, the results suggest that granting NPs and PAs more autonomy from physicians and allowing them to prescribe a full range of medications increases the use of medically appropriate cancer screenings. However, when joint and several liability reform is in place, the net effect of broadening NP and PA licenses becomes negative. This suggests that NPs and PAs respond more strongly to malpractice liability and reforms to that liability when they possess broader licenses. When they can practice with more autonomy, they lose some or all of the protection from liability that comes with having a supervising physician, so tort reforms affect their behavior to a greater extent.

B. Results for Medically Inappropriate Cancer Screenings

In general, broader licensing laws increase the use of medically appropriate cancer screenings (except when joint and several liability reform is in place). While these results suggest that the healthcare system is better able to provide medically indicated tests when NPs and PAs possess broader licenses, I also find evidence that increased NP authority (but not, in general, increased PA authority) leads to an increase in medically *inappropriate* cancer screenings. For mammograms and clinical breast exams, a medically inappropriate screening is defined as any screening on a woman 39 or younger, and for pap smears, a medically inappropriate screening is defined as any screening on a woman 66 or older.[63]

Table 7 reports regression results for the effect of licensing and liability laws on medically inappropriate screenings. Similar to its effect on appropriate screenings, joint and

[63] I excluded women 40-49 from both types of breast cancer screenings since the ACS guidelines include them in their definition of appropriate screenings.

several liability reform reduces the use of medically inappropriate mammograms and pap smears. Collateral source rule reform, on the other hand, increases the use of medically inappropriate pap smears. When NPs gain independence from physicians, inappropriate mammograms and clinical breast exams increase by 8 and 7 percentage points, respectively. However, increased PA authority has no effect on inappropriate screenings.

Similar to the results for appropriate cancer screenings, Tables 8 and 9 report the net effect of licensing laws across different tort regimes for NPs and PAs, respectively, to facilitate the interpretation of the multiple interaction terms reported in Table 7. In Table 8, Panel A reports net effects for mammograms, Panel B reports net effects for clinical breast exams, and Panel C reports net effects for pap smears. The pattern of effects of NP licensing and liability laws on medically inappropriate screenings is similar to the pattern of effects of these variables on appropriate screenings; although, non-zero net effects are more sporadic for inappropriate than appropriate screenings. In general, inappropriate screenings tend to increase in response to granting NPs broader licenses when no tort reforms are in place and when reforms which directly reduce damages, like noneconomic damages caps and collateral source rule reform, are in place. However, inappropriate screenings tend to decrease when NPs gain broader licenses when joint and several liability reform is in place. Table 9 reports the net effects of PA licensing laws on inappropriate cancer screenings across different tort regimes. Again, a similar pattern emerges, but none of the changes in inappropriate cancer screenings are due to a general effect of PA licensing laws.

In general, the same incentive structures created by licensing and liability laws that affect the provision of medically appropriate cancer screenings almost certainly drive the changes observed in inappropriate cancer screenings as well. However, the increase in inappropriate

cancer screenings in response to legal changes, particularly increased NP authority, may be problematic since these may represent wasted healthcare resources. The next section discusses the overall effect of licensing and liability laws on quality and welfare.

C. Discussion, Robustness, and Sensitivity

The estimated effects of NP and PA licensing laws and tort reforms on cancer screenings imply three important results. First, NPs and PAs respond differently to malpractice liability and tort reforms when they can practice with more autonomy and therefore are more exposed to liability. Because patients lose some or all of their claims against supervising physicians when NPs and PAs gain greater autonomy, NPs and PAs are at greater risk for liability when they possess broader licenses. Given this greater risk, they respond more strongly to tort reforms, as evidenced by the net negative effect of broader licenses when joint and several liability reform has been enacted.

Second, neither licensing laws nor tort reforms unambiguously improve or harm quality. Absent joint and several liability reform, increasing the authority of NPs and PAs increases the use of both appropriate and inappropriate cancer screenings. When joint and several liability reform is in place, this increased authority generally results in a decrease in both appropriate and inappropriate cancer screenings. Instead of implying a change in healthcare quality, these effects suggest that licensing and liability laws simply alter how providers supply and patients consume healthcare services. Thus, while licensing and liability laws can increase the consumption of medically indicated services, they can also result in a waste of healthcare resources.

The ambiguous effects of licensing and liability laws on healthcare quality extend to welfare in general as well. The increased use of medically appropriate cancer screenings when

states relax their licensing laws may or may not outweigh the loss of healthcare resources associated with the increased use of inappropriate cancer screenings. Additionally, given the current research into the overall usefulness of cancer screenings more generally, it is not possible to determine whether the increased use of both appropriate and inappropriate breast cancer screenings is welfare enhancing. For example, Gøtzsche and Jørgensen (2013) systematically review published research on breast cancer screening and conclude that the benefits of mammography may have been overstated (see also Saquib et al. 2015). They also explain that many women may undergo unnecessary treatment (including surgery, radiation therapy, and chemotherapy) as a result of the increase in screenings,[64] and they note that little evidence supports the conclusion that mammography reduces overall mortality. Future work in both medicine and economics can better elucidate whether cancer screenings are welfare enhancing.

Third, while the results do not imply an improvement in quality or welfare, they do suggest that regulating the supply side of healthcare markets (the healthcare workforce) can be just as effective at changing how patients consume healthcare services as regulating the demand side of the market (insurance carriers). For example, Bitler and Carpenter (2014) find that insurance mandates requiring coverage of screening mammograms increased the usage of these tests. Their estimated effects are of similar magnitude as the effects I estimate for NP and PA licensing laws, suggesting that regulating the supply and demand sides of healthcare markets can have similar effects on healthcare services consumption and are therefore substitutable to some degree. Future work can evaluate this substitutability in other contexts, but this substitutability

[64] Interestingly, their conclusions that increased use of mammography may lead to unnecessary (and unpleasant) treatment may help to explain the negative effect of joint and several liability reform. If NPs and PAs fear liability for the damages suffered by patients as a result of unnecessary treatment, they may be less inclined to refer those patients for cancer screenings when they are more likely to share in the liability for those unnecessary treatments with joint and several liability reform in place.

has important implications for the Affordable Care Act (ACA) and future healthcare regulation that seeks to alter how healthcare is delivered. The results developed in this chapter imply that instead of focusing so heavily on the demand side as the ACA did,[65] future regulations designed to affect healthcare consumption could focus more specifically on the supply side and the healthcare workforce.

To confirm the robustness of the results reported above, I run a series of alternative specifications. First, because the dependent variable in each specification is whether an individual received a screening in the last two years, I re-estimate all of the models using one- and two-year lags of all of the legal variables. While the magnitudes of the coefficients change somewhat, the results are largely similar. However, caution should be used when considering these lagged effects since they necessarily involve legal changes prior to 1998, which may not represent actual changes in the autonomy of NPs and PAs. Second, I alter the dependent variable in each of the models. I include indicators for whether an individual received a screening in the last year and last three years.[66] Again, the magnitudes of the coefficients change somewhat, and some of the interaction terms between licensing and liability laws increase in statistical significance. However, the results are qualitatively the same.

In addition to changing the nature of the dependent and independent variables, I also include additional covariates. As noted above, the variation in insurance benefits examined by Bitler and Carpenter (2014) had generally subsided by the start of the period I consider; however, including indicators for the insurance mandates they consider does not meaningfully alter the

[65] This is not to suggest that the ACA was devoid of supply side regulations. For example, the Act included provisions to expand the number of primary care residency positions available to medical school graduates.
[66] In other work, Bitler and Carpenter (2014) focus on mammograms in the last year as their preferred specification while Frakes and Jena (2014) focus on mammograms in the last two years.

results. Additionally, the ACA mandated coverage for cancer screenings beginning in 2010, but including an indicator for this has little effect on the results.

VI. Conclusion

Ensuring healthcare quality has been an important policy goal ever since governments began regulating healthcare markets. In this chapter, I focus on state regulations of the healthcare workforce and how those regulations increase or decrease the quality of healthcare provided, as measured by the rate of medically appropriate and inappropriate cancer screenings. I find that broader NP and PA licensing laws generally increase the use of medically appropriate cancer screenings and that broader NP laws increase the use of inappropriate screenings. However, when joint and several liability reform is in place, broader NP and PA licensing laws generally result in few cancer screenings. This differential effect of licensing laws across tort regimes suggests that NPs and PAs respond differently to malpractice liability and tort reforms when they bear more responsibility for their own liability because they posses broader licenses.

In general the results suggest that, in contrast to improving or harming quality, broader NP and PA licensing laws tend to indiscriminately increase or decrease the consumption of both appropriate and inappropriate cancer screenings, depending on the presence of joint and several liability reform. In other words, licensing and liability laws tend to increase or decrease consumption of healthcare services rather than improve or harm the quality of healthcare delivered to patients. While the evidence presented here suggests that licensing and liability laws have an ambiguous effect on healthcare quality, that evidence implicates future policy decisions both about how healthcare professionals are licensed and about how state statutes should intervene in traditional tort law. In particular, because the estimated effects are similar to the

effects of changing regulations on the demand side of the healthcare market, future policymakers should consider using supply side regulations in place of or in addition to demand side regulations to alter how healthcare is delivered to the population.

References

Avraham, Ronen. 2011. ‘‘Database of State Tort Law Reforms (DSTLR 4th),’’ Northwestern Law & Econ Research Paper No. 06-08; University of Texas Law, Law and Econ Research Paper No. 184. Available at SSRN: http://ssrn.com/abstrac1/4902711.

Avraham, Ronen, and Max Schanzenbach. 2010. "The Impact of Tort Reform on Private Health Insurance Coverage," 10 *American Law and Economics Review* 319-355.

Bitler, Marianne, and Christopher Carpenter. 2014. "Health Insurance Mandates, Mammography, and Breast Cancer Diagnoses," Working paper.

Buppert, Carolyn. 2012. *Nurse Practitioner's Business Practice and Legal Guide*. Bethesda, Maryland, Jones and Bartlett Learning.

Cano-Urbina, Javier, and Daniel Montanera. 2014. "Investigating Defensive Medicine: The Role of Access," Working Paper.

Currie, Janet, and W. Bentley Macleod. 2008. ‘‘First Do No Harm? Tort Reform and Birth Outcomes,’’ 123 *Quarterly Journal of Economics* 795–830.

Dubay, Lisa, Robert Kaestner, and Timothy Waidmann. 1999. ‘‘The Impact of Malpractice Fears on Cesarean Section Rates,’’ 18 *Journal of Health Economics* 491–522.

Dueker, Michael J., Ada K. Jacox, David E. Kalist, and Stephen J. Spurr. 2005. "The Practice Boundaries of Advanced Practice Nurses: An Economic and Legal Analysis," 27 *Journal of Regulatory Economics* 309–329.

Finkelstein, Amy, Sarah Taubman, Bill Wright, Mira Bernstein, Jonathan Gruber, Joseph P. Newhouse, Heidi Allen, Katherine Baicker, and the Oregon Health Study Group. 2012. "The Oregon Health Insurance Experiment: Evidence from the First Year," 127 *Quarterly Journal of Economics* 1057-1106.

Frakes, Michael. 2013. "The Impact of Medical Liability Standards on Regional Variations in Physician Behavior: Evidence from the Adoption of National-Standard Rules," 103 *American Economic Review* 257 – 276.

Frakes, Michael, and Anupam Jena. 2014. "Does Medical Malpractice Law Improve Healthcare Quality?," Working paper.

Gilman, Daniel J. and Tara Isa Koslov. 2014. "Policy Perspectives: Competition and the Regulation of Advanced Practice Nurses." Federal Trade Commission Report.

Gøtzsche, Peter, and Karsten Jørgensen. 2013. "Screening for breast cancer with mammography," Cochrane Database of Systematic Reviews 2013, Issue 6.

Institute of Medicine. 2011. *The Future of Nursing: Leading Change, Advancing Health*. Washington, DC: The National Academies Press.

Kessler, Daniel P., and Mark McClellan. 1996. ''Do Doctors Practice Defensive Medicine?,'' 111 *Quarterly Journal of Economics* 353–390.

Kessler, Daniel P., William M. Sage, and David J. Becker. 2005. ''Impact of Malpractice Reforms on the Supply of Physicians Services,'' 293 *Journal of the American Medical Association* 2618–2625.

Kleiner, Morris M. 2006. *Licensing Occupations: Ensuring Quality or Restricting Competition?*. Kalamazoo, Michigan, Upjohn Institute.

Kleiner, Morris M., Allison Marier, Kyoung Won Park, and Coady Wing. 2014. "Relaxing Occupational Licensing Requirements: Analyzing Wages and Prices for a Medical Service," NBER Working Paper No. 19906.

Kolstad, Jonathan and Amanda Kowalski. 2010. "The Impact of Health Care Reform on Hospital and Preventive Care: Evidence from Massachusetts," NBER Working Paper #16102.

Kornhauser, Lewis A., and Elizabeth, Klee. 2007. "Comparisons of the Incentive to Insolvency under Different Legal Regimes," 36 *Journal of Legal Studies* 141–170.

Kornhauser, Lewis A., and Richard L. Revesz. 1989. "Sharing Damages Among Multiple Tortfeasors," 98 *Yale Law Journal* 831–884.

Kuo, Yong-Fang, Figaro Loresto, Jr., Linda Rounds, and James Goodwin. 2013. "States With the Least Restrictive Regulations Experienced the Largest Increase in Patients Seen by Nurse Practitioners," 32 *Health Affairs* 1236-1243.

Lurie, Nicole, Willard G. Manning, Christine Peterson, George A. Goldberg, Charles A. Phelps, and Lee Lillard. 1987. "Preventive Care: Do We Practice What We Preach?" 77 *American Journal of Public Health* 801-804.

Mello, Michell, Allen Kachalia, and Sarah Goodell. 2006. “Medical Malpractice—Update.” New Brunswick, NJ: Robert Wood Johnson Foundation, Research Synthesis Report #10.

National Governors Association. 2012. “The Role of Nurse Practitioners in Meeting Increasing Demands for Primary Care.” National Governors Association Paper.

National Governors Association. 2014. “The Role of Physician Assistants in Health Care Delivery.” National Governors Association Paper.

Naylor, Mary and Ellen Kurtzman. 2010. “The Role of Nurse Practitioners in Reinventing Primary Care,” 29 *Health Affairs* 893 – 899.

Newhouse, Robin P., Julie Stanik-Hutt, Kathleen M. White, Meg Johantgen, Eric B. Bass, George Zangaro, Renee F. Wilson, Lily Fountain, Donald M. Steinwachs, Lou Heindel, and Jonathan P. Weiner. 2011. “Advanced Practice Nurse Outcomes1990-2008: A Systematic Review,” 29 *Nursing Economics* 230-250.

Neyman, J., and Elizabeth L. Scott. 1948. "Consistent Estimates Based on Partially Consistent Observations" 16 *Econometrica* 1-32.

Perry, John J. 2009. “The Rise and Impact of Nurse Practitioners and Physician Assistants on Their Own and Cross-Occupation Incomes,” 27 *Contemporary Economic Policy* 491–511

Saquib, Nazmus, Juliann Saquib, and John PA Ioannidis. 2015. “Does screening for disease save lives in asymptomatic adults? Systematic review of meta-analyses and randomized trials,” *International Journal of Epidemiology* (*forthcoming*).

Schiff, Gordon, Ann Louise Puopolo, Anne Huben-Kearney, Winnie Yu, Carol Keohane, Peggy McDonough, Bonnie R. Ellis, David W. Bates, Madeleine Biondolillo. 2013. “Primary Care Closed Claims Experience of Massachusetts Malpractice Insurers,” 173 *Journal of the American Medical Association Internal Medicine* 2063 – 2068.

Stange, Kevin. 2014. “How Does Provider Supply and Regulation Influence Health Care Markets? Evidence from Nurse Practitioners and Physician Assistants,” 33 *Journal of Health Economics* 1-27.

Traczynski, Jeffrey and Victoria Udalova. 2014. “Nurse Practitioner Independence, Health Care Utilization, and Health Outcomes” Working paper.

Tables

Table 1: Overview of Cancer Screenings

Panel A

Type of Screening	Screens for	Medically Appropriate Population
Mammogram	Breast Cancer	Females 50 years and older
Clinical Breast Exam	Breast Cancer	Females 50 years and older
Pap Smear	Cervical Cancer	Females 21 to 65 years

Panel B

Type of Screening	Screens for	Medically Inappropriate Population
Mammogram	Breast Cancer	Females 39 years and younger
Clinical Breast Exam	Breast Cancer	Females 39 years and younger
Pap Smear	Cervical Cancer	Females 66 years and older

Notes: the definition of medically appropriate population comes from the screening guidelines of the American Cancer Society and the US Preventative Task Force.

Table 2: Predicted Effects

Panel A: NPs	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Complete Supervision	baseline	+	+	-	ambiguous[1]
Independence	+	+	+	-	ambiguous[1]
Limited Cont. Subst. Authority	baseline	+	+	-	ambiguous[1]
Full Cont. Subst. Authority	+	+	+	-	ambiguous[1]

Panel A: PAs	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Onsite Supervision	baseline	+	+	-	ambiguous[1]
Remote Practice	+	+	+	-	ambiguous[1]
Limited Cont. Subst. Authority	baseline	+	+	-	ambiguous[1]
Full Cont. Subst. Authority	+	+	+	-	ambiguous[1]

Notes: Each cell reports the predicted direction of the net effect of the licensing law on the left and the tort reform listed above.
[1]The net effect of a given licensing law when all three major tort reforms have been passed is ambiguous because the magnitude of the licensing law's effect in jurisdictions which have passed JSLR may or may not exceed the magnitude of the licensing law's effect when other reforms have been passed.
CSR = collateral source rule reform
JSLR = joint and several liability reform

Table 3: Summary Statistics for Cancer Screenings

	Mammogram	Breast Exam	Pap Smear
Population	0.736	0.707	0.748
	(0.441)	(0.455)	(0.434)
NP Independence	0.733	0.713	0.725
	(0.442)	(0.452)	(0.446)
Supervision Required	0.737	0.705	0.754
	(0.440)	(0.456)	(0.431)
NP Controlled Substances	0.744	0.717	0.748
	(0.437)	(0.451)	(0.434)
NP Limited Authority	0.727	0.695	0.747
	(0.445)	(0.460)	(0.435)
PA Remote Practice	0.743	0.719	0.750
	(0.437)	(0.450)	(0.433)
Onsite Supervision	0.729	0.694	0.746
	(0.445)	(0.461)	(0.436)
PA Controlled Substances	0.748	0.724	0.745
	(0.434)	(0.447)	(0.436)
PA Limited Authority	0.725	0.691	0.750
	(0.447)	(0.462)	(0.433)
Noneconomic Cap	0.732	0.698	0.733
	(0.443)	(0.459)	(0.442)
No Cap	0.739	0.712	0.757
	(0.439)	(0.453)	(0.429)
Collateral Source Reform	0.741	0.711	0.745
	(0.438)	(0.453)	(0.436)
No Reform	0.727	0.699	0.752
	(0.446)	(0.459)	(0.432)
Joint and Several Reform	0.726	0.697	0.737
	(0.446)	(0.460)	(0.440)
No Reform	0.767	0.736	0.779
	(0.423)	(0.441)	(0.415)

Notes: Reported means represent the rate of medically appropriate cancer screenings. Standard deviations are reported in parentheses. Each grouping of legal variables consists of mutually exclusive categories.

Table 4: Regression Results for the Effect of NP and PA Laws on Medically Appropriate Cancer Screenings

Variables	(1) Mammogram	(2) Breast Exam	(3) Pap Smear
Tort Reforms			
Noneconomic damages cap	0.000	-0.003	-0.018
	(0.012)	(0.011)	(0.014)
Collateral source rule reform	0.020	-0.001	0.013
	(0.014)	(0.014)	(0.017)
Joint and several reform	-0.011**	-0.006	0.001
	(0.005)	(0.004)	(0.005)
NP Laws			
Independence from MD	0.040***	0.041*	0.054***
	(0.010)	(0.023)	(0.019)
NP Controlled Substances	0.028**	0.025**	-0.005
	(0.013)	(0.011)	(0.016)
(Independence)x(Nonecon cap)	-0.010	-0.022	-0.025
	(0.010)	(0.024)	(0.018)
(Independence)x(CSR)	0.028**	0.016	0.018
	(0.013)	(0.030)	(0.020)
(Independence)x(JSLR)	-0.060***	-0.059**	-0.066***
	(0.012)	(0.024)	(0.020)
(NP Cont. Subst.)x(Nonecon cap)	-0.006	0.015	0.027**
	(0.009)	(0.013)	(0.013)
(NP Cont. Subst.)x(CSR)	0.004	-0.014	0.021**
	(0.010)	(0.017)	(0.009)
(NP Cont. Subst.)x(JSLR)	-0.037**	-0.026	-0.027
	(0.018)	(0.023)	(0.021)
PA Laws			
Remote Practice	0.046***	0.006	0.025
	(0.015)	(0.019)	(0.019)
PA Controlled Substances	0.004	-0.000	0.002
	(0.011)	(0.008)	(0.013)
(Remote practice)x(Nonecon cap)	0.018	-0.010	-0.001
	(0.020)	(0.018)	(0.018)
(Remote practice)x(CSR)	-0.015	-0.014	-0.038*
	(0.017)	(0.021)	(0.020)
(Remote practice)x(JSLR)	-0.054***	-0.008	-0.015
	(0.014)	(0.017)	(0.018)

(PA Cont. Subst.)x(Nonecon cap)	0.005	0.035***	0.012
	(0.007)	(0.010)	(0.010)
(PA Cont. Subst.)x(CSR)	0.001	0.031**	0.009
	(0.010)	(0.012)	(0.009)
(PA Cont. Subst.)x(JSLR)	-0.000	-0.029***	-0.005
	(0.011)	(0.011)	(0.011)
State fixed effects	yes	yes	yes
Year fixed effects	yes	yes	yes
State-specific time trends	yes	yes	yes
Observations	928,245	928,245	1,155,231
R-squared	0.078	0.089	0.079

Notes: The dependent variable in each specification is an indicator for whether the individual received the cancer screening listed at the top of each column. All specifications include only individuals who fit the guidelines for the relevant screening. All specifications include state and year fixed effects and state-specific linear time trends. Standard errors clustered by state are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.
CSR = collateral source rule reform
JSLR = joint and several liability reform

Table 5: Net Effects of NP Licensing Laws on Medically Appropriate Cancer Screenings Across Tort Regimes

Panel A: Mammogram	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Complete Supervision	baseline	0	0	-1.1	-1.1
Independence	4	4	6.8	-3.1	-0.3
Limited Cont. Subst. Authority	baseline	0	0	-1.1	-1.1
Full Cont. Subst. Authority	2.8	2.8	2.8	-2	-2

Panel B: Breast Exam	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Complete Supervision	baseline	0	0	0	0
Independence	4.1	4.1	4.1	-1.8	-1.8
Limited Cont. Subst. Authority	baseline	0	0	0	0
Full Cont. Subst. Authority	2.5	2.5	2.5	2.5	2.5

Panel C: Pap Smear	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Complete Supervision	baseline	0	0	0	0
Independence	5.4	5.4	5.4	-1.2	-1.2
Limited Cont. Subst. Authority	baseline	0	0	0	0
Full Cont. Subst. Authority	0	2.7	2.1	0	4.8

Notes: Each cell reports the net percentage point increase or decrease in the probability of receiving he relevant cancer screening associated with the licensing law on the left and the tort reform above. Effects for Panel A are calculated from column (1) of table 4, effects for Panel B are calculated from column (2) of table 4, and effects for Panel C are calculated from column (3) of table 4. All effects are calculated only from coefficient estimates that are statistically significant.
CSR = collateral source rule reform
JSLR = joint and several liability reform

Table 6: Net Effects of PA Licensing Laws on Medically Appropriate Cancer Screenings Across Tort Regimes

Panel A: Mammogram	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Onsite Supervision	baseline	0	0	-1.1	-1.1
Remote Practice	4.6	4.6	4.6	-1.9	-1.9
Limited Cont. Subst. Authority	baseline	0	0	-1.1	-1.1
Full Cont. Subst. Authority	0	0	0	-1.1	-1.1

Panel B: Breast Exam	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Onsite Supervision	baseline	0	0	0	0
Remote Practice	0	0	0	0	0
Limited Cont. Subst. Authority	baseline	0	0	0	0
Full Cont. Subst. Authority	0	3.5	3.1	-2.9	3.7

Panel C: Pap Smear	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Onsite Supervision	baseline	0	0	0	0
Remote Practice	0	0	-3.8	0	-3.8
Limited Cont. Subst. Authority	baseline	0	0	0	0
Full Cont. Subst. Authority	0	0	0	0	0

Notes: Each cell reports the net percentage point increase or decrease in the probability of receiving he relevant cancer screening associated with the licensing law on the left and the tort reform above. Effects for Panel A are calculated from column (1) of table 4, effects for Panel B are calculated from column (2) of table 4, and effects for Panel C are calculated from column (3) of table 4. All effects are calculated only from coefficient estimates that are statistically significant.
CSR = collateral source rule reform
JSLR = joint and several liability reform

Table 7: Regression Results for the Effect of NP and PA Laws on Medically Inappropriate Cancer Screenings

Variables	(1) Mammogram	(2) Breast Exam	(3) Pap Smear
Tort Reforms			
Noneconomic damages cap	-0.011	-0.013	0.011
	(0.012)	(0.017)	(0.015)
Collateral source rule reform	0.012	0.012	0.021*
	(0.013)	(0.017)	(0.012)
Joint and several reform	-0.028*	-0.005	-0.020*
	(0.015)	(0.007)	(0.010)
NP Laws			
Independence from MD	0.081***	0.073***	0.018
	(0.013)	(0.027)	(0.030)
NP Controlled Substances	0.018	-0.025	0.042
	(0.011)	(0.016)	(0.025)
(Independence)x(Nonecon cap)	-0.009	-0.048*	0.013
	(0.012)	(0.027)	(0.028)
(Independence)x(CSR)	-0.026***	0.017	-0.053
	(0.009)	(0.023)	(0.037)
(Independence)x(JSLR)	-0.051***	-0.068**	-0.020
	(0.012)	(0.029)	(0.031)
(NP Controlled Substances)x(Nonecon cap)	-0.019**	0.056***	-0.002
	(0.009)	(0.014)	(0.013)
(NP Controlled Substances)x(CSR)	-0.000	0.027*	0.008
	(0.010)	(0.016)	(0.014)
(NP Controlled Substances)x(JSLR)	-0.027*	-0.014	-0.057**
	(0.015)	(0.024)	(0.028)
PA Laws			
Remote Practice	-0.007	0.008	0.038
	(0.014)	(0.031)	(0.041)
PA Controlled Substances	0.002	-0.011	-0.005
	(0.011)	(0.010)	(0.024)
(Remote practice)x(Nonecon cap)	0.005	-0.013	-0.019
	(0.014)	(0.017)	(0.027)
(Remote practice)x(CSR)	-0.000	-0.036	-0.042
	(0.013)	(0.027)	(0.037)
(Remote practice)x(JSLR)	0.006	0.007	-0.021

	(0.014)	(0.029)	(0.023)
(PA Controlled Substances)x(Nonecon cap)	-0.009	0.015*	0.031
	(0.009)	(0.009)	(0.021)
(PA Controlled Substances)x(CSR)	-0.027*	0.023	0.012
	(0.015)	(0.016)	(0.021)
(PA Controlled Substances)x(JSLR)	0.027	-0.010	0.003
	(0.017)	(0.016)	(0.027)
State fixed effects	yes	yes	yes
Year fixed effects	yes	yes	yes
State-specific time trend	yes	yes	yes
Observations	416,558	416,558	475,310
R-squared	0.052	0.107	0.092

Notes: The dependent variable in each specification is an indicator for whether the individual received the cancer screening listed at the top of each column. All specifications include only individuals who do not fit the guidelines for the relevant screening. All specifications include state and year fixed effects and state-specific linear time trends. Standard errors clustered by state are reported in parentheses. *** significant at 1% level; ** significant at 5% level; * significant at 10% level.
CSR = collateral source rule reform
JSLR = joint and several liability reform

Table 8: Net Effects of NP Licensing Laws on Medically Inappropriate Cancer Screenings Across Tort Regimes

Panel A: Mammogram	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Complete Supervision	baseline	0	0	-2.8	-2.8
Independence	8.1	8.1	5.5	0.2	-2.4
Limited Cont. Subst. Authority	baseline	0	0	-2.8	-2.8
Full Cont. Subst. Authority	0	-1.9	0	-5.5	-7.4

Panel B: Breast Exam	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Complete Supervision	baseline	0	0	0	0
Independence	7.3	2.5	7.3	0.5	-4.3
Limited Cont. Subst. Authority	baseline	0	0	0	0
Full Cont. Subst. Authority	0	5.6	2.7	0	8.3

Panel C: Pap Smear	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Complete Supervision	baseline	0	2.1	-2	0.1
Independence	0	0	2.1	-2	0.1
Limited Cont. Subst. Authority	baseline	0	2.1	-2	0.1
Full Cont. Subst. Authority	0	0	2.1	-7.7	-5.6

Notes: Each cell reports the net percentage point increase or decrease in the probability of receiving he relevant cancer screening associated with the licensing law on the left and the tort reform above. Effects for Panel A are calculated from column (1) of table 7, effects for Panel B are calculated from column (2) of table 7, and effects for Panel C are calculated from column (3) of table 7. All effects are calculated only from coefficient estimates that are statistically significant.
CSR = collateral source rule reform
JSLR = joint and several liability reform

Table 9: Net Effects of PA Licensing Laws on Medically Inappropriate Cancer Screenings Across Tort Regimes

Panel A: Mammogram	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Onsite Supervision	baseline	0	0	-2.8	-2.8
Remote Practice	0	0	0	-2.8	-2.8
Limited Cont. Subst. Authority	baseline	0	0	-2.8	-2.8
Full Cont. Subst. Authority	0	0	-2.7	-2.8	-5.5

Panel B: Breast Exam	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Onsite Supervision	baseline	0	0	0	0
Remote Practice	0	0	0	0	0
Limited Cont. Subst. Authority	baseline	0	0	0	0
Full Cont. Subst. Authority	0	1.5	0	0	1.5

Panel C: Pap Smear	No Reforms	Nonecon cap	CSR	JSLR	All Reforms
Onsite Supervision	baseline	0	2.1	-2	0.1
Remote Practice	0	0	2.1	-2	0.1
Limited Cont. Subst. Authority	baseline	0	2.1	-2	0.1
Full Cont. Subst. Authority	0	0	2.1	-2	0.1

Notes: Each cell reports the net percentage point increase or decrease in the probability of receiving he relevant cancer screening associated with the licensing law on the left and the tort reform above. Effects for Panel A are calculated from column (1) of table 7, effects for Panel B are calculated from column (2) of table 7, and effects for Panel C are calculated from column (3) of table 7. All effects are calculated only from coefficient estimates that are statistically significant.
CSR = collateral source rule reform
JSLR = joint and several liability reform