Abstract

In this paper, we evaluate and document the relationship between health insurance markets and medical malpractice insurance markets. While prior research indicates that liability mitigating tort reform measures affect healthcare markets, we are the first study, to our knowledge, to assess the relationship of the two insurance markets. Using NAIC data on Health Insurers and Medical Malpractice insurers, we test whether health insurance losses per capita influence medical malpractice insurance losses per capita, and vice-versa. Our results thus far indicate that, in a contemporaneous setting, each market has a statistically significant impact on the other market. In a dynamic setting, we find that health insurance market claims impact future medical malpractice insurance market claims.
1. Introduction

In the U.S., the markets for health insurance and medical malpractice insurance are structurally distinct, i.e., completely different insurers participate in these two markets, and the buyers are distinct groups: medical providers, on the one hand, and employers and individual consumers on the other. Both markets, however, remain in the spotlight of regulatory and legal attention as the country seeks control over the increasing amount spent on health care. Although regulatory attention varies substantially across states, insurers in these markets are highly regulated in such areas as rate and form filing. Further, health insurers are constrained by an increasing number of state mandates that require insurance coverage of specified services, types of providers, and care settings. The performance of insurers in both markets also depends on the legal environment, which has evolved substantially in the past few decades, especially as it relates to awards in medical malpractice cases.

While prior studies have examined the relation that exists between different product markets (e.g. Coulson and Stuart, 1995), few studies have specifically examined the relation between medical malpractice markets and health care markets. Those that do have examined the effects of tort reform on physicians’ behaviors and only a small number of studies have examined the effects of tort reform on the health insurance market (e.g. Avraham and Schanzenbach, 2010; Morrisey, Kligore, and Nelson, 2008). Furthermore, to our knowledge, no prior studies have examined the effect of various changes in the health insurance market on the market for medical malpractice insurance. We find this omission in the literature particularly striking because both markets are inextricably linked via patients. That is, physicians’ interactions with patients may impact the liability exposure of physicians and physicians’ interactions with the patients may impact health insurer claims.

We believe that a better understanding of this relationship is especially important for predicting the direct and indirect effects of public policies designed to control the cost of health care services and increase the number of people with health insurance. If health insurance markets and medical malpractice insurance markets do exhibit a relationship then regulatory actions, such as the Patient Protection and Affordable Care Act of 2010, that are intended to target health insurance markets may have unexpected
and unintended consequences in the medical malpractice insurance market. Likewise, if the markets are linked, legislation designed to reduce the size of medical malpractice awards or influence medical professional liability markets may also exert some undue influence on health insurance markets. As such, an analysis of the relation between health insurance markets and medical malpractice insurance markets is of value to public policy makers, health insurance market participants, medical malpractice insurance market participants, and financial economists.

Therefore, the purpose of our analysis is to evaluate and document the relationship between the medical malpractice insurance market and the health insurance market. We detail the ways in which the two markets are interconnected and then develop two sets of competing hypotheses related to the impact that the health insurance market has on medical malpractice insurance market and vice versa. We then test our competing hypotheses in a contemporaneous setting, in order to determine the effect each market has on the other in a single time period. We also test our hypotheses in a dynamic setting which provides a more robust view of the interactions between health insurance markets and medical malpractice insurance markets.

By way of preview, our results indicate that the health insurance market and the medical malpractice insurance market impact the operations of the other in a contemporaneous setting and in a multiple period setting. In particular, we find that health insurance claims in year $t$ negatively impact medical malpractice insurance claims in year $t$ and also that medical malpractice insurance claims in year $t$ negatively impact health insurance losses in year $t$. We also find year $t$ health insurance claims impact medical malpractice insurance claims in years $t + 1$ and $t + 2$. Thus, our analysis provides the first evidence, to our knowledge, that health insurance markets and medical malpractice insurance markets exhibit a direct relationship.

Our paper proceeds as follows. In Section 2, we provide background on relevant literature. In Section 3, we develop our competing hypotheses. In Section 4 we describe our data and empirical framework and in Section 5 we discuss our methods and results. Finally, we make concluding remarks in Section 6.
2. Background

In the existing literature, researchers have examined the relation between different markets or different products. The economics literature’s analysis of vertically and horizontally integrated firms and products (e.g. Ohanian, 1994; Coulson and Stuart, 1995; Chipty, 2000; Hastings and Gilbert, 2005) as well as product aftermarkets (e.g. Hall, 1997; Davis and Murphy, 2005) provides a starting point for an analysis the nature of the relationship between health and medical malpractice insurance markets. For example, Hall (1997) discusses the replacement ink aftermarket and notes that consumers may be adversely impacted by aftermarkets while Davis and Murphy (2000) note that the linking of Microsoft hardware and Microsoft Internet Explorer may impact other web-browsing software competitors and ultimately negatively impact consumers.

If health insurance alters the nature of the physician-patient interaction in such a way that physicians’ liability exposure is affected, then health insurance markets may exert an influence on medical malpractice insurance markets. Interestingly, the body of literature which explores the tendency of health insurance coverage to encourage utilization of healthcare services generally finds that increased coverage for health care services does, in fact, results in an increase in the use of these services. For example, the comprehensive literature review by Buchmueller, Grumbach, Kronick, and Kahn (2005) indicates that health insurance coverage positively impacts outpatient utilization, inpatient utilization, and instances of preventative care for children and adults. In a setting of Medicare beneficiaries, Coulson and Stuart (1995) provide evidence that insurance coverage is positively associated with individuals’ decisions to use prescription drugs. Additional evidence on the role of insurance in the utilization of healthcare services comes from Cameron, Trivedi, Milne, and Piggot (1988), who, using Australian Health Survey data, find evidence of higher utilization of medical services for persons with higher levels of health insurance coverage.

Many studies that examine the impact health insurance coverage has on the utilization of health services do so in the context of moral hazard and adverse selection. For example, Gao, Powers, and Wang (2009) using health insurance data from China, find evidence of a positive relation between ex-post health
claims and additional insurance purchases which suggests, in the adverse selection framework, that people purchase health insurance for access to services. Barros, Matilde, and Sans-de-Galdeano (2008) utilize data from the Portuguese civil servant insurance scheme and find that the presence of health insurance is positively associated with the number of medical tests a patent receives. Also, Savage and Wright (2003) find that private health insurance increased the expected duration of hospital stays. As it relates to our study, the body of literature which addresses the impact of health insurance on utilization is important because it generally indicates that health insurance impacts the types and frequency of healthcare services used by the insured patient.

Also of importance is that many of the previously mentioned studies find that demographic characteristics impact levels of health utilization to some extent (e.g. Gao et al., 2009; Barros et al., 2008; Savage and Wright, 2003; Manning and Marquis, 1996). In some cases, demographic factors such as income or education levels are found to impact the likelihood of having health insurance coverage, which then impacts the degree of utilization of health services. In other cases, demographic factors such as family size or age impact the nature of the services required, which ultimately impacts healthcare utilization. Finally, demographic factors associated with health status, such as tobacco use or alcohol consumption, are considered because these factors may impact the desire for health insurance or the level of care used under a given health insurance policy. Therefore, in our analysis, we also consider the potential effects of demographic characteristics on health insurance claims.²

We also note that the rise of managed care organizations (MCO) has fundamentally altered the nature of the interaction between patients and physicians.³ Under managed care, physicians are usually

² As additional support for the impact of demographics on healthcare utilization, we note that Van de Ven and Van Praag (1981) find that income, education, family size, and age influence an individual’s desire for an insurance policy that lacks any deductible. Additionally, Bundorf (2002) examines the relation between group health insurance offerings and employee characteristics and finds that employee characteristics impact the characteristics of employer sponsored health insurance plans. Bundorf, Herring and Pauly (2010) also find that adverse selection in the group insurance market is affected by the socio-economic status of the insureds.

³ To the extent that MCOs influence physicians’ behavior, we expect that the implementation of managed care mechanisms affects the liability of physicians. Other changes to the health insurance industry, including those that mandate insurers to provide coverage for certain providers, treatments or treatment settings, are also likely to affect the liability of physicians due to increased utilization or an expanded scope of services. We elaborate more on this issue in our hypothesis development.
remunerated via a fee for service schedule or capitation payments. When compared to the former fee for service mechanisms applied in the traditional indemnity-based health insurance system, managed care payment schemes have been found to have a considerable effect on physician behavior. For example, Melichar (2009) finds that physicians spend more time with non-capitated patients than with capitated patients. Godsen, Forland, Kristiansen, Sutton, Leese, Guiffrida, Sergison, and Pederson (2009) find that, relative to capitation, fee for service arrangements result in more primary care visit and visits to specialists. Also, Casalino, Nicholson, Gans, Hammons, Morra, Karrison, and Levinson (2009) find evidence that physicians and other healthcare professionals spend a considerable amount of time interacting with MCOs and the authors estimate that the cost of this interaction is approximately $23 - $31 billion per year. In addition, some studies discuss the fact that different forms of managed care types are associated with differences in cost sharing and, to the extent that cost sharing impacts utilization of healthcare services, managed care arrangements may further impact healthcare utilization.

While the evidence from prior literature indicates that health insurance impacts the physician-patient interaction via affecting the type and frequency of services used by the patient, there also exist several studies which evaluate the cost of medical malpractice insurance as it relates to physicians’ delivery of healthcare services. For example, Kessler and McClellan (2002) find that, among Medicare beneficiaries, liability-reducing tort reforms reduce the rates of defensive medicine in areas with high and low managed care enrolment. Baiker, Fisher, and Chandra (2007) find a positive relation between Medicare spending, especially on imaging services, and malpractice awards which provides support for the hypothesis that malpractice awards drive defensive medicine rates. Other studies, such as Kessler, Summerton, and Graham (2006), largely confirm the findings that the medical malpractice market

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4 See Robinson (2001) for a review of the various forms of physician payment and analysis of how different mechanisms, including systems that blend various forms, affect physician incentives to provide the appropriate level of care, accept risk, and maintain productivity.

5 From the financial perspective of the provider, providers are not typically well equipped to take on capitation contracts and partly in response to this concern, providers continue to form larger groups and unite with other health care organizations, in order to increase their capital base and ability to bear risk (Simon and Emmons; 1997).

6 For example, Buchmueller et al., 2005 state that “...some HMOs make less use of cost sharing as a means of discouraging utilization and tend to cover preventative services.” (pp 8).
influences the healthcare market via impacting physicians’ behaviors.  
Thus, it may be that medical malpractice insurance markets affect the way that physicians interact with patients, in terms of the frequency or types of services rendered, which ultimately translate into an effect on health insurance markets.

Additional studies which have addressed the effect of the medical malpractice market on the health insurance market reinforce our supposition that the two insurance markets are linked. For example, Avraham and Schanzenbach (2010) examine the impact of tort reform on private insurance coverage, using individual-level survey data from 1982 through 2007. They test the competing hypotheses that either 1) tort reform may reduce damage awards and defensive medicine costs or 2) tort reform may increase providers’ costs by reducing physicians’ caretaking incentives. The authors find that tort reform increases insurance coverage rates, which they assert provides support for their first hypothesis. In a similar study, Avraham, Dafny, and Schanzenbach (2009) find that the enactments of various tort reform measures reduce group self insured health insurance premiums by 1 to 2 percent.

If medical malpractice insurance markets do influence health insurance markets, then it is important to understand factors which affect medical malpractice insurance claims levels. We note that the majority of such studies find that the most influential malpractice tort reform measures are caps on noneconomic damages, which reduce incurred losses and loss ratios (e.g. Grace and Leverty 2008; Viscusi et al, 1993; Viscusi and Born, 1995; Born and Viscusi, 1998; Viscusi and Born, 2005). For example, after adjusting for loss development, Born, Viscusi and Baker (2009) find that non-economic damage caps are particularly influential in reducing medical malpractice losses and increasing insurer profitability. We also draw on additional studies, such as Danzon (1984) and Danzon (1986), which

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7 We note, however, that a few studies have found that tort reforms do not impact medical decisions. For example, Sloan and Shadle (2009), using survey data as well as Medicare data, conclude that medical decisions are not significantly affected by tort reform measures.

8 In contrast, however, Morrissey, Kligore, and Nelson (2008) examine the relation between non-economic damage caps and employer-sponsored health insurance premiums and do not find any evidence that damage caps impact the cost of employer sponsored health insurance. Specific to insurance markets, given somewhat conflicting results in prior literature, our analysis is valuable in that it provides insight into the ongoing debate regarding the relation between the two insurance markets.
develop an empirical tests of the frequency and severity of medical malpractice insurance claims and find that factors such as the size of the urban population, the age of the population, the medical exposure, and legal environment all have a varying impact on the frequency and severity of medical malpractice insurance claims. More recent studies, such as Avraham (2007) and Durrance (2010), have also considered the impact that tort reforms and demographic factors have on medical malpractice suits in the context of tort reform.

In sum, prior studies indicate that health insurance coverage impacts the types and frequency of services available to the patient, which provides support for the notion that health insurance markets impact the nature of the physician-patient interaction. If the physician-patient interaction is altered in a way that affects physicians’ liability exposure, then health insurance markets may impact medical malpractice insurance markets. In addition, prior studies indicate that medical malpractice liability exposure impact the frequency and types of services rendered to the patient by the physician, which provides support for the notion that medical malpractice insurance markets impact the nature of the physician-patient interaction. If physician-patient interaction is altered in a way that impact health insurance claims, then medical malpractice insurance markets may impact health insurance markets. Thus, health insurance markets and medical malpractice insurance markets may exert an influence on each other.

While our survey of the literature reveals that many researchers have studied health insurance markets and medical malpractice insurance markets, few have examined the relationship between the two markets. Those studies that have examined the relation between the markets have evaluated the impact that medical malpractice reducing tort reform measures have on healthcare services and health insurance premiums. To our knowledge, no studies have examined the interrelatedness of the insurance markets assuming effects in both directions. Thus, we contribute to the existing literature by simultaneously analyzing the effect each market has on the other and also by evaluating the effect of the health insurance market on the medical malpractice insurance market, and vice versa.

3. Hypothesis Development
3.1 The Impact of the Health Insurance Markets on Medical Malpractice Insurance Markets

We begin our discussion of the direct relation between the markets for medical malpractice insurance and health insurance by focusing on the effect of the health insurance market on the medical malpractice insurance market operations. The state-level regulatory nature of insurance markets, coupled with certain microeconomic data limitations, makes it most appropriate to discuss these markets in the context of a state. Thus, when we refer to health insurance markets, the health insurance market of a given state is implied and similarly, medical malpractice insurance markets implies the medical malpractice insurance market of a given state.

The potential impact that health insurance markets have on medical malpractice insurance markets is described as follows. First, state health insurance regulation and population characteristics influence the insurance contracts offered by health insurers in that state.\(^9\) The extent or type of coverage subsequently affects the health care services that may be obtained by the insured.\(^10\) Specifically, the health insurance coverage has the potential to influence health care utilization decisions, which reflect the interaction between patients and physicians.

Next, it follows that variations in physician-patient interactions may be related to patients’ health outcomes. For example, more visits to the doctor might result in a different health outcome than fewer visits to the doctor for the same ailment or the use of a more expensive diagnostic test may result in different health outcome when compared to a less expensive diagnostic test. Since adverse health outcomes are subcomponents of health outcomes, physician-patient interactions may influence the frequency and/or severity of adverse health outcomes, which may ultimately affect medical malpractice insurance claims. Thus, we expect the medical malpractice insurance market will be affected by changes in the health insurance market and we would expect a significant relationship between measures of health insurance claims and medical malpractice insurance claims.

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\(^9\) For example, all states have varying types of mandated health insurance benefits which, in many cases, affect the contract design and claims levels of health insurers (The Center for Affordable Health Insurance Report, 2010).

\(^10\) This implication is supported by prior literature relating to moral hazard and adverse selection, which indicates that the presence of health insurance affects utilization of services (e.g. Gao, Powers, and Wang, 2009; Barros et al 2008).
While we expect claims in these two insurance markets to be related, the nature of this relationship is ambiguous, which leads to our first two sets of competing hypotheses. Consider, first, a scenario where a positive relation exists between the nature of physician–patient interactions (i.e. utilization rates and/or types of treatments) and liability claims against physicians. That is, when levels of patient utilization and treatments increase, as indicated by higher levels of health insurance claims, physicians may have more chances to render poor medicine to patients, commit a medical error, or simply be charged with some form of medical negligence which results in a liability claim. Here, the result is an increase in liability exposure for physicians, which ultimately leads to higher medical malpractice claims.

Thus, we arrive at our first competing hypothesis regarding the relation between the medical malpractice insurance market and the health insurance market:

**H1A (Increased Liability Exposure Hypothesis):** As health insurance claims increase, medical malpractice claims increase due to an increase in liability exposure for physicians.

We also consider the potential for health insurance markets to have a negative impact on medical malpractice insurance. Here, higher levels of health insurance claims affect the nature of the physician–patient interaction in ways that reduce liability exposure such as diagnostic imaging, preventative prescription drugs, routine physical exams, or follow-up exams. In this scenario, physicians’ liability would be reduced by the utilization of health insurance and healthcare services due to: 1) an increase in preventative procedures that reduce the number of cases of high risk, complicated procedures which increase the likelihood of a medical malpractice claim and 2) improved defenses against physician negligence via the ability to show attorneys/mediators/juries that the physician made every effort to correctly diagnose and/or treat a patient. The end result is that health insurance claims would have a negative impact on medical malpractice insurance claims.

11 Formally, we hypothesize that:

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11 Further, it is possible that the relationship, whether positive or negative, is not linear. That is, perhaps the provision of additional services increases the likelihood of a malpractice claim but at a decreasing rate. We consider the potential for a nonlinear relationship in future analyses.
H1B (Reduced Liability Exposure Hypothesis): As health insurance claims increases, medical malpractice losses decrease due to the liability mitigating effects of increased cases of physician–patient interaction.

2.3 The Impact of Medical Malpractice Insurance Markets on Health Insurance Markets

We now consider the impact of the medical malpractice insurance market on the health insurance market and begin by noting that prior studies related to tort reform and medical malpractice suggest that medical malpractice insurance markets influence the provision of health care services and health insurance prices. Of particular importance to our hypothesis development is that several prior studies provide evidence that medical malpractice liability impacts the nature of the medical care given by physicians. Thus, while our hypotheses and analyses relating to the specific effect of medical malpractice insurance markets on health insurance markets are unique, they are grounded in literature which suggests liability exposure impacts services rendered by physicians.

As it pertains to the development of our hypotheses, we assert that the medical malpractice insurance market exerts an influence on the health insurance market in the following manner. First, medical malpractice insurance regulation and/or demographic characteristics of a state are associated with a certain level of medical malpractice insurance claims. Physicians in the state perceive their risk of being sued for medical malpractice, where this perception may be based on prior experience with a medical malpractice claim levied against them, personally, or by observing medical malpractice claims being brought against other physicians. Markets with higher levels of medical malpractice insurance claims in implies that more physicians have been sued for medical malpractice and/or the dollar awards of medical malpractice awards have been higher. Further, in markets with higher levels of medical malpractice

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12 See, for example, Danzon (1986), Danzon, Pauly, and Kingston (1990), Dubay, Kaestner, and Waidmann (2001), and Avraham and Schanzenbach (2010).

13 For example, Kessler and McClellan (2002) find that, among Medicare beneficiaries, liability reducing tort reform reduces the rates of defensive medicine in areas with high and low managed care enrolment. Baiker, Fisher, and Chandra (2007) find a positive relation between Medicare spending, especially on imaging services, and malpractice awards which provides support for the hypothesis that malpractice awards drive defensive medicine rates. Other studies, such as Kessler, Summerton, and Graham (2006), largely confirm the findings that the medical malpractice market influences the healthcare market via impacting physicians’ behaviors.
insurance claims, physicians are more likely to know of other physicians who have experienced a medical malpractice lawsuit. We assert that all three of these outcomes likely influence the physician’s perception of their liability exposure.

Because differences in levels of medical malpractice insurance claims observed by physicians influence their perception of liability exposure, physicians may alter interactions with patients. More specifically, a physician’s perceived liability exposure may influence the frequency and types of services provided to patients and thus medical malpractice insurance claims should be correlated with the nature of the physician – patient interaction. Differences in the ways that a physician interacts with a patient, in terms of the types and level of services, consequently affect the level of health insurance claims. For example, all else equal, a physician with a higher perceived liability exposure may order more/less tests for insured patients, see more/less patients with health insurance, or see more/less of certain insured patient groups, all of which would impact the level of claims in health insurance markets. Thus, we would expect the health insurance market will be affected by changes in the medical malpractice insurance market, resulting in a significant relationship between measures of medical malpractice insurance claims and health insurance claims.

Here, again, the direction of the impact of the medical malpractice market on the health insurance market is ambiguous. For example, consider a market where medical malpractice claims levels are such that physicians perceive their liability exposure to be high. In an effort to mitigate against liability lawsuits in this market, physicians may alter the way in which they interact with patients in ways that increase the frequency or cost of services delivered to the patient. For example, physicians may increase instances of defensive medicine resulting in increased or over-prescribed treatments, diagnostic tests, and/or prescription drugs, all of which would translate to higher total claims for health insurers. Thus, we propose our first competing hypothesis, as it relates to the effect of medical malpractice insurance on health insurance, which we refer to as the Over-Treatment Hypothesis:

\[ H2A \text{ (Over-Treatment Hypothesis): Markets with high medical malpractice insurance claims are associated with higher levels of health insurance claims.} \]
Under our competing hypothesis, the *Under Treatment Hypothesis*, physicians operating in markets with high levels of medical malpractice liability exposure are minimalist practitioners. In this setting, higher perceived levels of liability exposure by physicians alter the physician–patient interaction in such a way that physicians render less frequent and/or less expensive services. In the extreme case, physicians may even withdraw from rendering services to certain classes of insured groups. For example, a physician, for fear of the liability implications of actions such as prescribing the wrong medicine or of recommending the wrong treatment, practices the least amount of medicine required to satisfy the patient. Riskier procedures, additional medications, and additional consultations with patients—and consequently health insurance claims—are all kept to a minimum in order to curb the likelihood of a medical malpractice lawsuit. Formally, we hypothesize that:

\[ H_{2B} (\text{Under-Treatment Hypothesis}): \text{Markets with high medical malpractice insurance claims are associated with lower levels of health insurance claims.} \]

4. Data and Empirical Framework

To test our two sets of competing hypotheses, we use data from the National Association of Insurance Commissioners (NAIC), as well as data from other sources such as the US Census Bureau, Bureau of Labor and Statistics (BLS) and the Center for Disease Control (CDC), for the years 2002 through 2009.\(^\text{14}\) The NAIC provide detailed data pertaining to insurance company financial operations including but not limited to assets, liabilities, line of business operations, premiums, and losses. The advantage of the NAIC database is that it reports the losses which each medical malpractice insurer and each health insurer report in each state of operation. After applying filters to account for reporting inaccuracies and other non-logical values, we aggregate the by-state loss data to obtain the state level medical malpractice insurance losses and the state level health insurance losses for each state, for every

\(^\text{14}\) Much of the health insurance data before the year 2002 are not reported in a manner which necessary for our empirical analysis and, as such, we are forced to limit the beginning of our sample period to the year 2002. We are forced to limit the end of our sample to the year 2009 due to the fact that certain variables from the BLS are only available through 2009.
year in our sample.\textsuperscript{15} Our final data set contains state-level information relating to medical malpractice insurer losses and health insurer losses for all states except California, which was excluded from our analysis due to data inconsistencies. We then include several state-level variables, provided from various sources, such as median income, population age, and hospital admissions. Detailed descriptions of variable sources are given below and summary statistics for our sample are presented in Table 1.\textsuperscript{16}

In developing a test of our two sets of competing hypotheses, we must develop a model to evaluate how health insurance claims impact medical malpractice insurance claims and how medical malpractice insurance claims impact health insurance claims. Furthermore, relevant literature suggests that health insurance markets and medical malpractice insurance markets share many state-level factors which influence claims levels. For example, factors such as age, income, and procedure rates all may influence an individual’s decision to file a medical malpractice claim as well as the size of the damages award (e.g. Avraham 2006). However, age, income, and procedure rates also influence an individual’s healthcare utilization levels and the cost of health insurance claims (e.g. Gao et al., 2009; Savage and Wright, 2003). Thus, it appears that relationship between the two markets is an endogenous relationship which can be expressed as

\[ M\text{MInsLoss} = f(Health\text{InsLoss}, Med\text{MalDPE}, State\text{MktFactors}) \]  
1)

\[ Health\text{InsLoss} = f(M\text{MInsLoss}, Health\text{InsDPE}, State\text{MktFactors}) \]  
2)

where descriptions for all variables are found in the ensuing subsections:

4.1 Insurance Specific Variables

\( M\text{MInsLoss} \) is defined as state-wide medical malpractice insurance losses incurred, per capita, for state \( i \) in year \( t \) and this variable is indicative of medical malpractice insurance claims levels. For each

\textsuperscript{15} We filter all observations at the firm level, before aggregating the data to the state level. In particular, we delete observations of insurers with assets, surplus, premiums, losses, and enrolment of less than 1,000, and also of those insurers with loss ratios less than 1 percent and greater than 500 percent, in order to ensure that our sample contains viable, operating insurance companies.

\textsuperscript{16} For all variables except the number of cigarette users, \( n = 378 \). This due to the omission of California data and due to the fact that data on family and general practitioners from the BLS is omitted in different states during different years. While omission of the family and general practitioner data does not appear to be systematic, we are searching for alternative sources of data related to physician specialty to incorporate into future analyses. For cigarette users, \( n = 377 \) due to the fact that these data were not available for the state of Hawaii in 2009.
year in our sample, we aggregate the by-state medical malpractice insurance losses incurred data to obtain the state level medical malpractice insurance losses incurred. We then divide state level total losses incurred in year $t$ by the state population in year $t$ in order to obtain our final variable. Data on medical malpractice insurance losses are from the NAIC and were accessed using SNL Financial. State population data are from the US Census Bureau.

$HealthInsLoss$ is defined as state-wide health insurance losses incurred, per capita, for state $i$ in year $t$ and this variable is indicative of health insurance claims levels. For each year in our sample, we aggregate the by-state health insurance losses incurred data to obtain the state total level of health insurance losses incurred for state $i$ in year $t$. We then divide state level total health insurance losses incurred in year $t$ by the state population in year $t$ in order to obtain our final variable. Data on health insurance losses are from the NAIC raw data files and state population data are from the US Census Bureau.

$MMInsDPE$ is defined as state-wide medical malpractice insurance direct premiums earned (DPE), per capita, for state $i$ in year $t$. The sources and tabulation of this variable are the same as $MMInsLoss$ except that medical malpractice insurance DPE is used instead of medical malpractice insurance losses incurred. We include this variable only in the equation where medical malpractice insurance losses per capita is the dependent variable in order to control for the impact that levels of services demanded in the medical malpractice insurance market has on medical malpractice insurance losses. We expect medical malpractice insurance DPE per capita to positively impact medical malpractice insurance losses incurred per capita.

$MMInsNPE$ is defined as state-wide health insurance net premiums earned (NPE), per capita, for state $i$ in year $t$. The calculation and sources of this variable are the same as describe in $MMInsLoss$ except that health insurance NPE is used instead of health insurance losses incurred. We include this variable only in the equation where health insurance losses incurred per capita is the dependent variable in order to control for the impact that levels of services demanded in the health insurance market has on
health insurance losses. We expect that health insurance DPE per capita is positively related to health insurance losses incurred per capita.

4.2 State Market Factors

StateMktFactors is a vector of state level variables hypothesized to impact the level of claims in medical malpractice insurance markets and health insurance markets. Variables included as StateMktFactors are Metropolitan Percentage, Specialists, Young, Over 65, Median Income, Hospital Admissions, Non-Economic Damage Cap, HMO Enrolment, Large Liability Claims, Mandated Liability Coverage, and Statute Limits. Definitions and sources of all variables included as StateMktFactors are given as follows.

Metropolitan Percentage is the percentage of a state’s residents living in a metropolitan area for state i in year t. This variable is included in many prior studies related to medical malpractice insurance claims levels (e.g. Danzon, 1984, 1986; Avraham, 2009) and captures population characteristics that may influence the frequency and/or severity of medical malpractice insurance awards.\textsuperscript{17} For example, differences in access to legal services, income levels, frivolous claims levels, educational attainment, or occupational status may exist between individuals residing in metropolitan areas and those residing in rural areas. Since urbanization has been found in previous studies to have a positive impact on total malpractice claims filed, we expect that Metropolitan Percentage will have a positive impact on medical malpractice insurance losses incurred. In addition, differences in the number of persons residing in metropolitan areas may also be associated with differences in access to health insurance, health services, or socioeconomic status, all of which may impact health insurance claims. We therefore expect that Metropolitan Percentage will have an impact on health insurance losses incurred, though we do not hypothesize on the direction of the impact. We obtain the number of persons living in a metropolitan area during our sample period from the US Census Bureau.

\textsuperscript{17} Danzon (1986) states that “[Danzon 1984] concluded that urbanization was the single most important factor in contributing to interstate differences in medical malpractice claims. The results [of Danzon 1986] confirm that conclusion…” (pp 69).
Specialists is the difference between family and general practitioner physicians, per capita, and total active physicians, per capita, in a given state for a given year and has been included in prior studies which evaluate the medical malpractice liability markets (e.g. Barker 1992). The variable captures the fact that surgeons may be exposed to higher levels of medical malpractice liability exposure. In a broader sense, Specialists also accounts for the possibility that differences in the physician labor force impact medical malpractice insurance losses in ways related to contract design and pricing.\textsuperscript{18} Therefore, we hypothesize that Specialists will have a positive impact on medical malpractice insurance incurred losses. In addition, we expect that a greater relative amount of specialists in a given state will also have a positive impact on health insurance losses incurred. This is due to the fact that higher levels of Specialists in a given state will likely be associated with higher physician remuneration rates, which would translate into higher levels of health insurance losses per capita. We collected data on active physicians from the US Census Bureau and data on family and general practitioners from the BLS.

Young is defined as the number of persons under the age of 18, scaled by the total population of each state for a given year. The medical malpractice insurance literature indicates that the size of medical malpractice awards are partially determined by the expected remaining lifetime of a person (e.g. Avraham 2007) and we thus expect that higher levels of persons under the age of 18 per capita will positively impact the medical malpractice insurance losses incurred per capita. In addition, since Young is also a measure of the number of dependents in a given state for a given year, it serves a proxy for the number of dependents. Prior studies suggest that measures such as family size and the number of depends may be positively associated with access to group health insurance and would thus influence the demand and/or utilization of health services (e.g. Manning and Marquis, 1996; Savage and Wright, 2003). As such, we expect that Young will have a positive impact on health insurance incurred claims per capita. The source for the number of person under the age of 18 is the US Census Bureau.

\textsuperscript{18} For example, if medical malpractice insurance companies prefer to insure family and general practitioners, as opposed to specialists, then malpractice insurers operating in states with higher levels of family and general practitioners may have different levels of loss exposures than insurers that do not operate in such states.
Over 65 is defined as the number of persons per capita, age 65 or older, residing in state $i$ for year $t$. Higher levels of utilization of healthcare services, which are likely for persons over the age of 65, may affect physicians’ malpractice liability exposure and thus impact medical malpractice insurance claims frequency. Additionally, if the size of malpractice awards are partially based on potential income lost, then higher levels of persons over 65 would be associated with lower dollar levels of medical malpractice awards. Thus, we hypothesize that Over 65 will significantly influence medical malpractice insurance losses incurred, but the direction of the impact remains ambiguous. As it relates to health insurance losses, Over 65 may be associated with differences in the frequency and type of healthcare utilization or the likelihood of being insured under a group health insurance policy, which would influence health insurance losses. In addition, in unreported analysis, we find that the number of persons over the age of 65 per capita is positively and significantly correlated with Medicare enrolment per capita. To the extent that levels of Medicare enrolment impact private health insurance losses, Over 65 is also all the more likely to influence health insurance losses. While we expect that Over 65 will have a significant impact on health insurance losses, the direction is ambiguous. Data on persons age 65 or older come from the US Census Bureau.

Median Income is the median income, in 2009 dollars, in a given state for a given year. Median income is likely to be positively associated with factors such as potential earning lost due to iatrogenic injury, the ability to pay for legal services, educational attainment, or general socioeconomic status. We therefore believe that higher levels of Median Income will be associated with higher levels of medical malpractice insurance losses. Higher levels of Median Income are also likely correlated with the likelihood of having a group insurance policy (e.g. the number of employed persons or persons with higher educational attainment) or lower levels of preventable diseases associated with a lower socioeconomic status, which would impact the levels of health insurance losses. Furthermore, in unreported analysis, we find that Median Income is negatively correlated with Medicaid enrolment so, to the extent that Medicaid programs act as a residual health insurance market mechanism, Median Income would have an additional influence on health insurance losses. We hypothesize that median income will
have a positive influence on the level of health insurance losses incurred per capita. Data regarding
*Median Income* are acquired from the US Census Bureau.

*Hospital Admissions* is defined as the number of persons, per capita, admitted to a hospital in state \( i \) during year \( t \). In prior literature, such as Danzon (1987), the frequency of surgical procedures is found to positively impact medical malpractice insurance losses, presumably by creating more liability exposure for physicians. We were unable to obtain by-state data on the number of surgical procedures for the years in our sample period and we instead use *Hospital Admissions* to capture differences in physicians’ liability exposure among states. As such, we hypothesize that higher levels of persons admitted to hospitals, per capita, will have a positive impact on medical malpractice insurance claims. We also believe that *Hospital Admissions* will have a positive impact on health insurance losses in that higher levels of admissions is indicative of higher utilization levels or access to health insurance, which are associated with higher levels of health insurance claims. Data on the number of persons admitted to a hospital in each state for a given year are from the American Hospital Association and made available online via The Kaiser Family Foundation.

*Non Economic Damage Cap* is a dummy variable equal to one if a given state has a limit on non economic damage award amounts in a given year. As discussed in a previous section, tort reforms, and specifically non economic damage caps, have been found to negatively impact medical malpractice insurance losses at the state level and at the insurer level. We therefore expect that this variable will have a negative impact on medical malpractice insurance losses. Prior studies which have examined the impact of tort reforms on health insurance (e.g. Avraham et al 2007) find that these reforms have a negative impact on health insurance premiums. To the extent that a reduction in health insurance premiums is associated with a reduction in health insurance losses, we expect that *Non Economic Damage Cap* will negatively impact on health insurance losses incurred per capita. For our sample period, we collect by state data on *Non Economic Damage Cap* from the American Tort Reform Association.

*HMO Enrolment* is the number of persons enrolled in a Health Maintenance Organization divided by the total state population for state \( i \) in year \( t \). Previous research discusses that fact that the cost
containment techniques of managed care organizations influence physician liability exposure (e.g. Born, Karl, and McCullough, 2009) and, due to this potential impact on malpractice exposure, HMO penetration rates have been included in many empirical analyses relating to liability, tort reform, and medical malpractice insurance losses (e.g. Kessler and McClellan, 2002; Avraham, 2007). We therefore include HMO Enrolment in our analysis and hypothesize it will exhibit a positive relationship with medical malpractice insurance losses due to the potential for cost containment measures to increase physicians’ professional liability exposure. As it relates to health insurance claims, higher levels of HMO Enrolment are likely to be indicative of higher levels of group or private insurance coverage and utilization of healthcare services. We therefore expect the number of persons enrolled in an HMO per capita to positively impact health insurance losses incurred per capita. For the years 2002 through 2008, we obtain data on HMO Enrolment from the US Census Bureau. Since these data are not available through the US Census Bureau for the year 2009, we obtain 2009 HMO Enrolment from Healthleaders, Inc, via the Kaiser Family Foundation.

Large Liability Claims is given as the number of medical malpractice insurance awards in excess of $1 million, scaled by state population, for a given state in a given year. Since this variable captures all (i.e. insured and uninsured) malpractice awards in excess of $1 million, it serves to control for losses that may not be captured by medical malpractice insurance companies, such as losses by uninsured physicians or losses in excess of the limit of a malpractice liability policy. It is also likely that more malpractice awards in excess of $1 million are associated with higher malpractice loss levels, in general, and therefore we expect that Large Liability Claims will be positively related to medical malpractice insurance losses incurred. As previously mentioned, prior literature suggests the size of liability awards is partially related to income levels and socioeconomic status. Therefore, to the extent that higher levels of Large Liability Claims are indicative of higher levels of income and socioeconomic status, we would expect that Large Liability Claims be positively related to health insurance losses incurred as well. Data here are obtained from the National Practitioner Data Bank and made available through the US Department of Health and Human Services.
Mandated Liability Coverage is a dummy equal to one if state $i$ mandates that physicians purchase some minimum amount of medical malpractice liability insurance coverage in year $t$. In our sample, 10 states have mandated that physicians purchase medical malpractice liability insurance and over our sample period, this variable is time invariant. If a state mandates the purchase of physician professional liability insurance, then physicians are not legally allowed to go “bare” and we might expect higher levels of insurance purchases in these state. If a state has a higher volume of medical malpractice insurance purchases, then we would expect that state to have a higher volume of medical malpractice insurance losses and we thus hypothesize Mandated Liability Coverage to have a positive impact on medical malpractice insurance losses incurred per capita. The presence of Mandated Liability Coverage may also be an indication of a higher level of regulatory stringency. To the extent that the regulatory stringency of a state results in increased mandated health insurance benefits or pricing differences, we would also expect Mandated Liability Coverage to positively impact health insurance losses incurred per capita. Information on whether a state mandates the purchase of professional liability coverage was hand collected from a variety of sources including American Medical Association (AMA) reports and manual inspection of state statutes.\textsuperscript{19}

Statute Limits is the number of years an individual has to bring a professional liability lawsuit against a physician after the injury was discovered, as mandated by statute, for each state in a given year. We include this variable to account for the possibility that states with longer statutes of limitations provide extra time for an individual to bring a lawsuit which may ultimately increase insured malpractice loss levels. Thus, we would expect that Statute Limits be positively associated with medical malpractice insurance losses incurred per capita. We believe that statutes of limitations may also be reflective of a state’s attitude toward patient wellbeing and thus may also be associated with health insurance regulation that increases health insurance losses. For example, Massachusetts has a statute of repose of 7 years, one of the largest in our sample, and the state also passed a healthcare reform bill in 2006 that mandates health

\textsuperscript{19} Specifically, the AMA reports we use for help in identifying are statutes are “The Physician Professional Liability Market and Regulatory Environment” and “State Laws mandating Minimum Levels of Professional Liability Insurance”.

20
insurance coverage for residents. To the degree that Statute Limits is associated with state’s attitude
toward patient wellbeing, then we would expect the variable to positively impact health insurance losses
incurred.

5. Methods and Results

Before we formally test our two sets of competing hypotheses, we must first address the role that
timing plays in the relationship between health insurance markets and medical malpractice insurance
markets. We assert that the relationship between the markets may be either contemporaneous or dynamic
and we take time in subsection 5.1 to address the contemporaneous relationship that exists between health
insurance markets and medical malpractice insurance markets. In subsection 5.2, we address the dynamic
relationship that exists between health insurance markets and medical malpractice insurance markets.

5.1 The Contemporaneous Model

In this section, we discuss and test our hypotheses related to the relation between health
insurance markets and medical malpractice markets in a setting where one market’s level of claims in
year $t$ is related to the other market’s level of claims, also in year $t$. In this setting, health insurance claims
in year $t$ are associated with the nature of the physician – patient interaction in year $t$, the nature of the
patient – physician interaction in year $t$ impacts health outcomes in year $t$, and health outcomes in year $t$
affect medical malpractice claims in year $t$. Similarly, medical malpractice claims in year $t$ are associated
with physicians’ perception of liability exposure in year $t$, physician’s perception of liability exposure in
year $t$ impacts the nature of the physician – patient interaction in year $t$, and the nature of the physician –
patient interaction in year $t$ impacts health insurance claims in year $t$. Thus, testing of our competing
hypotheses requires that we evaluate the impact of year $t$ health insurance claims on year $t$ medical
malpractice insurance claims in year $t$ and vice versa.

As justification for the relevance of the contemporaneous model, we first note that health
insurance companies and medical malpractice insurance companies include loss reserves in their
calculation of incurred losses. The relevance is that losses incurred in year $t$ captures a large amount of
the claims liability of an insurance company resulting from the actions of insured risks in year $t$ but which
might not have actually been paid in year $t$. Thus by including losses incurred as our measure of health insurance claims and medical malpractice insurance claims, we minimize the potential distorting effect of differences in claims occurrence and claims payment. In addition, the short tailed nature of health insurance lines further mitigates problems associated with differences in timing between the occurrence of a claim and the payment of a claim. Also contributing to the case for the contemporaneous model is that preliminary evidence suggests that certain physicians self report adverse medical outcomes to medical malpractice insurance companies in cases where medical malpractice losses were ultimately not filed.\textsuperscript{20} Finally, manual inspection of statutes of limitations relating to medical malpractice lawsuits indicate that the vast majority of states have limits of between one and three years, which further eases distortions between claim occurrences and claims payment. In sum, given this evidence, we expect that health insurance claims and medical malpractice claims exhibit a contemporaneous relationship.

As previously described, we consider the relation between medical malpractice insurer claims and health insurer claims, expressed as total incurred losses per capita, to be endogenous. Therefore, we employ a two stage least squares (2SLS) procedure to test our hypotheses. Specifically, to test hypotheses 1A and 1B in a single period setting, we estimate a 2SLS model where medical malpractice insurer claims is the dependent variable and health insurer claims is the independent variable of interest. Conversely, to test hypotheses 2A and 2B, we estimate a 2SLS model such that the dependent variable is health insurer claims and the independent variable of interest is medical malpractice insurer claims. Formally, we express the relationship between the two markets as:

$$\text{MMInsLoss}_{it} = \alpha_{it} + \beta_1 \text{HealthInsLoss}_{it} + \beta_2 \text{MMDPE}_{it} + \beta_3 \text{StateMktFactors}_{it} + \gamma_i + \lambda_t + \epsilon_{it}$$  

$$\text{HealthInsLoss}_{it} = \alpha_{it} + \beta_1 \text{MMInsLoss}_{it} + \beta_2 \text{HealthInsNPE}_{it} + \beta_3 \text{StateMktFactors}_{it} + \gamma_i + \lambda_t + \epsilon_{it}$$

where

$\gamma$ = a vector of state dummy variables

$\lambda$ = a vector of year dummy variables

\textsuperscript{20} Preliminary analysis of the Texas Closed Claims database suggests that, in some cases, physicians notified medical malpractice insurance companies of adverse outcomes even in cases where no medical malpractice lawsuit was later filed. In future versions of this paper, we will provide further evidence on physician self reporting of adverse outcomes.
and all variable are defined previously in section 4.

As it pertains to the impact of health insurance claims on medical malpractice insurance claims, given in hypotheses 1A and 1B, we estimate a 2SLS model where $MMInsLoss$ is the dependent variable, $MMDPE$ and $StateMktFactors$ are included as controls, and $Smokers$ is used to instrument the endogenous variable, $HealthInsLoss$. Thus, the first stage of the 2SLS procedure regresses $HealthInsLoss$ on $Smokers$, $MMDPE$, and $StateMktFactors$ and the second stage regresses $MMInsLoss$ on the predicted value of $HealthInsLoss$ as well as $MMDPE$ and $StateMktFactors$. A positive and statistically significant coefficient on $HealthInsLoss$ would provide support for hypothesis 1A while a negative and statistically significant coefficient on $HealthInsLoss$ would provide support for hypothesis 1B.

Our instrument for $HealthInsLoss$, $Smokers$, is defined as the proportion of a given state’s population that smoke cigarettes on a regular basis. These data are survey data from the Behavioral Risk Factor Surveillance System conducted by the Centers for Disease Control and Prevention (CDC). As discussed in a previous section, health status can have an effect on healthcare utilization and health insurance claims levels and, consistent with prior studies, we employ $Smokers$ as an indicator of the population’s actual health status or perceived health status. To the extent that tobacco use is an indicator of actual or perceived health status, we expect that $Smokers$ is related to health insurance claims. In addition, in unreported tests, we find that $Smokers$ is not correlated with $MMInsLoss$ in a statistically significant manner, which suggests that the rate of tobacco use does not impact physician liability exposure. We therefore believe that $Smokers$ is a valid instrument to employ in our analysis.\(^{21}\)

Turning to hypotheses 2A and 2B, to examine the effect of medical malpractice insurance claims on health insurance claims, we estimate a separate 2SLS model where $HealthInsLoss$ is the dependent

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\(^{21}\) In unreported analysis, we employ $Cholesterol$, defined as the proportion of a given state’s population that have been told they have high blood cholesterol levels in a given year, as an instrument instead of $Smokers$ and find that the main results of our analysis remain unchanged. We believe that $Cholesterol$ would be positively related to health insurance claims as higher rates of persons with high cholesterol would indicate lower health status. In addition, literature related to medicine indicates that genetic factors play a larger role in determining cholesterol levels than do environmental factors (e.g. Heller, Faire, Pedersen, Dahlen, and McClearn, 1993; Cuchel and Rader, 2003), which is evidence that $Cholesterol$ may not be correlated with the same factors associated with the tendency to file a lawsuit.
variable, HealthInsNPE and StateMktFactors are included as controls, and Civil Cases is used to instrument the endogenous variable, MMInsLoss. In this model, the first stage of the 2SLS procedure regresses MMInsLoss on Civil Cases, HealthInsNPE and StateMktFactors and the second stage regresses HealthInsLoss on the predicted value of MMInsLoss as well as HealthInsNPE and StateMktFactors. A positive and statistically significant coefficient on MMInsLoss would provide support for hypothesis 2A while a negative and statistically significant coefficient on HealthInsLoss would provide support for hypothesis 2B.

Civil Cases, our instrument for MMInsLoss, is defined as the total number of incoming civil cases, for each state in a given year, as a proportion of the state’s population. Data related to Civil Cases are collected from the Inter-university Consortium for Political and Social Research (ICPSR) database. We believe that the number of civil caseloads per capita captures the degree of litigiousness in a state and that litigation levels are directly related to the number of medical malpractice insurance claims per capita, MMInsLoss. However, we would not expect that the number of incoming civil cases be correlated to HealthInsLoss and, in unreported analysis, we find that Civil Cases is correlated with MMInsLoss in a statistically significant way but not correlated with HealthInsLoss. Therefore, we employ Civil Cases as an instrument for MMInsLoss.

The second stage results of estimating our 2SLS models are presented in Table 2 below with robust standard errors.\(^22\) We first address the results of the model where the dependent variable is medical malpractice insurance losses per capita, given as equation 3. In this model, health insurance losses per capita is treated as endogenous and as a consequence, is instrumented by HealthInsFactors in the first stage of the 2SLS model. The F-statistic of the first stage model is significant at the one percent level and

\(^{22}\) We are forced to omit Statute Limits and Mandated Liability Coverage due to the time invariant nature of these variables. However, in results to be reported in future versions of this paper, we find that including Statute Limits and Mandated Liability Coverage, while omitting state and year fixed effects, does not alter the main results of our analysis. In addition, our main results are unchanged when we employ a three stage least squares (3SLS) analysis instead of a 2SLS analysis.
instrument validity tests support the validity of the instrument, *Smokers*.\(^{23}\) In addition, we use the Durbin-Wu-Hausman test of endogeneity to reject the null hypothesis that health insurance losses and medical malpractice insurance losses are exogenous at the one percent level. Thus, 2SLS is an appropriate method to model the impact of health insurance losses per capita on medical malpractice insurance losses per capita.

In the first column of Table 2, we show that health insurance losses incurred per capita has a negative coefficient that is statistically significant at the five percent level. Thus, even after controlling for state and year fixed effects, our results indicate that higher levels of health insurer claims per capita are associated with lower levels of medical malpractice insurer claims per capita in a particular state. This result is consistent with hypothesis 1B, termed the *Reduced Liability Exposure Hypothesis*, which states that the liability mitigating effects of higher levels of health insurance losses result in a reduction of medical malpractice insurance claims. From a broader perspective, our results confirm that the conduct and performance of the health insurance market does indeed have an impact on the conduct and performance of the medical malpractice insurance market.

Aside from our key variable of interest, health insurance losses per capita, we also note that several other variables in our model significantly impact medical malpractice losses in a state.\(^{24}\) Medical malpractice DPE per capita is positively and significantly associated with medical malpractice losses per capita, as expected, since more coverage is associated with more potential for claims. Consistent with prior literature and our hypothesis, we find that the coefficient on the non economic damage cap dummy is negative and statistically significant at the ten percent level, indicating that states with limits on damage awards are associated with lower medical malpractice insurance payment per capita. Also as expected, the

\(^{23}\) Using the Kleibergen-Paap statistic, we reject the null hypothesis of underidentification at the one percent level. In addition, using the Anderson-Rubin and Stock-Wright statistics, we reject the null hypothesis that the coefficient on *Smokers* is equal to zero at the one percent level.

\(^{24}\) When we estimate the 2SLS model without state and year fixed effects, we find that several additional state-level control variables have statistically significant coefficients in the hypothesized direction, which suggests that many state-level characteristics in the model reported in Table 2 are captured by the state and year dummy variables.
coefficient on per capita enrolment in HMOs is positive and statistically significant at the five percent level.

When we turn to the analysis of the impact of medical malpractice insurance losses on health insurance losses, found in the second column of Table 2, we find further evidence that the health insurance market and the medical malpractice insurance market are related. In this part of our analysis, our dependent variable is health insurance losses per capita and our independent variable of interest is medical malpractice insurance losses per capita, which we treat as endogenously determined in the system. Therefore, in the first stage of our 2SLS model, we instrument medical malpractice insurance losses per capita with Civil Cases. Tests for endogeneity and validity of instruments, described previously, indicate that 2SLS is appropriate and that our instruments are valid and properly identified.

When health insurance losses per capita is the dependent variable, our independent variable of interest, medical malpractice insurance losses per capita, has a negative coefficient that is statistically significant at the ten percent level. This result provides support for hypothesis 2B, the Under-Treatment Hypothesis. That is, our results indicate that higher levels of professional liability exposure are associated with physicians choosing to be minimalist practitioners, in terms of services rendered to patients with health insurance, in order to mitigate the likelihood of a medical malpractice lawsuit. This result is also consistent with physicians withdrawing from specialty areas or even electing to treat only certain patient groups. At this juncture in our analysis, we cannot distinguish whether physicians are treating less or withdrawing from services altogether and we leave this as an area of future analysis.

Additional control variables are also significant in our model. Health insurance net premiums earned (NPE) per capita is positive and significant, as expected since potential health care claims increase with an increase in coverage. In addition, consistent with prior literature, the coefficient on the non economic damage cap indicator variable is negative and significant. Again, in unreported analyses, we find that the omission of state and year dummies and the inclusion of Statute Limits and Mandated Liability does not alter the negative and significant coefficient on medical malpractice insurance losses.
per capita. In addition, a model without fixed effects yields several additional statistically significant coefficients on control variables.

In sum, our findings confirm a statistically significant contemporaneous relationship between health insurance markets and medical malpractice insurance markets. In particular, we find a negative and significant coefficient on health insurance losses per capita when medical malpractice insurance losses per capita is the dependent variable, which provides support for hypothesis 1B. We also find a negative and significant coefficient on medical malpractice insurance losses per capita when health insurance losses per capita is the dependent variable, which provides support for hypothesis 2B.

5.2 The Multiple Period Model

In this section, we test our hypotheses related to the relation between health insurance markets and medical malpractice markets in a setting where one market’s level of claims in year $t$ is related to the other market’s level of claims in year $t + n$. While evidence suggests that the contemporaneous model captures much of the effect that each market has on the other, there are certain settings where the claims levels of one market in year $t$ have an effect on the claims levels of the other market in year $t + n$. First, to the extent that physicians do not self-report adverse outcomes and patients do not file a medical malpractice claim until year $t + n$ for an injury that occurred in year $t$, incurred losses reported in year $t$ by medical malpractice insurers may not completely capture the resulting medical malpractice claims in year $t$. Additionally, levels of health insurance and medical malpractice insurance claims in year $t$ may have an impact on physicians’ or patients’ actions in year $t + n$. For example, if physicians perceive their liability exposure to be high in year $t$, they might not only alter practicing habits in year $t$ but also going forward. This implies that medical malpractice claims in year $t$ impact health insurance claims in year $t + n$. Because there is the potential for past claims levels in one market to impact the current levels of claims in another, we believe that the inclusion of a multiple period models adds robustness and validity to our hypothesis testing.

Therefore, in this multiple period setting, health insurance claims in year $t$ are associated with the nature of the physician–patient interaction year $t$, the nature of the patient–physician interaction in year
$t$ impacts health outcomes in year $t$, and health outcomes in year $t$ affect medical malpractice claims in year $t + n$. Similarly, medical malpractice claims in year $t$ are associated with physicians’ perception of liability exposure in year $t + n$, physician’s perception of liability exposure in year $t + n$ impacts the nature of the physician–patient interaction in year $t + n$, and the nature of the physician–patient interaction in year $t$ impacts health insurance claims in year $t + n$. Thus, testing of our competing hypotheses requires that we evaluate the impact of year $t$ health insurance claims on year $t + n$ medical malpractice insurance claims and vice versa.

As in the contemporaneous model, we assume that health insurance claims and medical malpractice insurance claims are endogenously determined. We initially considered two 2SLS models where, in the first model, health insurance claims in year $t$ is the dependent variable and medical malpractice insurance claims in year $t - n$ is the independent variable of interest and in the second model, medical malpractice insurance claims is the dependent variable in year $t$ and health insurance claims in year $t - n$ is the independent variable of interest. However, nature of the 2SLS procedure is such that in the first stage, time $t$ variables would be explanatory variables for medical malpractice or health insurance claims in year $t - n$. In order to compensate for this econometric issue inherent in the 2SLS procedure, we model the relationship of the two markets as:

\[
\begin{align*}
MMInsLoss_{it+n} &= \alpha_{it} + \beta_1HealthInsLoss_{it} + \beta_2MMDPE_{it} + \beta_3StateMktFactors_{it} + \gamma_i + \lambda_t + \epsilon_{it} \\
HealthInsLoss_{it+n} &= \alpha_{it} + \beta_1MMInsLoss_{it} + \beta_2HealthInsNPE_{it} + \beta_3StateMktFactors_{it} + \gamma_i + \lambda_t + \epsilon_{it}
\end{align*}
\]

where all variable are defined previously in section 4.

As it pertains to the dynamic impact of health insurance claims on medical malpractice insurance claims, given in hypotheses 1A and 1B, we estimate a 2SLS model where $MMInsLoss$ in year $t + n$ is the dependent variable and $StateMktFactors$ and $MMDPE$ in year $t$ are included as controls and $Smokers$ in year $t$ are used to instrument the endogenous variable, year $t HealthInsLoss$. Here, in the first stage of the 2SLS procedure, all variables are in period $t$. Since the dependent variable in the second stage is $MMInsLoss$ in year $t + n$ while the regressors are the predicted value of $HealthInsLoss$ in year $t$ as well as year $t MMDPE$ and $StateMktFactors$, we essentially employ year $t MMDPE$ and
*StateMktFactors* as proxies for MMDPE and *StateMktFactors* in year \( t + n \). In this context, a positive and statistically significant coefficient on year \( t \) *HealthInsLoss* would provide support for hypothesis 1A while a negative and statistically significant coefficient on year \( t \) *HealthInsLoss* would provide support for hypothesis 1B.

When we estimate this multiple period 2SLS model to evaluate hypotheses 1A and 1B, tests for endogeneity and instrument validity, described previously, indicate that this relationship remains endogenous and that our instrument is valid. Table 3 displays the second stage regression results, with robust standard errors, when health insurance losses incurred per capita in year \( t \) is our independent variable of interest and medical malpractice insurance incurred losses per capita in year \( t + n \) is the dependent variable. Here, for robustness, we estimate two versions of the model where medical malpractice losses in year \( t + 1 \) and \( t + 2 \), are used as dependent variables.\(^{25}\) We find a negative and significant coefficient on year \( t \) *HealthInsLoss* for the model when the dependent variable is year \( t + 1 \) and year \( t + 2 \) *MMIInsLoss*, which provides support for hypothesis 1B in a dynamic context. More specifically, this result suggests that health insurance claims in year \( t \) lead to physician–patient interactions which result in lower levels of medical malpractice claims in years \( t + 1 \) and year \( t + 2 \). Future analyses will evaluate the magnitude of the effect of health insurance claims on future medical malpractice insurance claims.

In both time periods \( t + 1 \) and \( t + 2 \), there are no significant control variable in the second stage of the regression. However, in unreported results, we find that the omission of state and year fixed effects does not change the sign or degree of statistical significance on the coefficient of health insurance losses per capita. In addition, excluding fixed effects results in statistical significance for many of the control variables, providing evidence that the *StateMktFactors* in year \( t \) are appropriate proxies for *StateMktFactors* in year \( t + 1 \) and \( t + 2 \). It thus appears that the state and year fixed effects remove the explanatory power of our control variables.

\(^{25}\) We limit our analysis to two periods due to our sample time period and the observation that the majority of states have statutes of limitations of two to three years or less.
Turning to the dynamic impact of medical malpractice claims on health insurance claims, given in hypotheses 2A and 2B, we employ a fixed effects linear regression framework to estimate equation 4 where year $t \text{MMInsLoss}$ and year $t + 1 \text{HealthInsLoss}$ are treated as exogenous. We do not employ a 2SLS procedure because tests for endogeneity indicate that the dynamic effect of medical malpractice claims on health insurance claims is not endogenous. In this context, a positive and statistically significant coefficient on year $t \text{MMInsLoss}$ would provide support for hypothesis 2A while a negative and statistically significant coefficient on year $t \text{MMInsLoss}$ would provide support for hypothesis 2B.

Table 3 displays the results of the fixed effects regression analysis when medical malpractice insurance losses incurred per capita in year $t$ is our independent variable of interest and health insurance losses incurred per capita in year $t + n$ is the dependent variable. Here, again, we estimate two versions of the model where medical malpractice losses in year $t + 1$ and $t + 2$ are used as dependent variables for robustness. Interestingly, we find that medical malpractice losses in year $t$ do not explain, in a statistically significant manner, health insurance losses in periods $t + 1$ or $t + 2$. Thus, we do not find support for hypothesis 1B or hypothesis 2B in a multiple period context. Of particular relevance is that a Granger Causality analysis, which will be incorporated into future versions of this paper, reveals that past health insurance claims Granger Cause current medical malpractice claims. Thus, our lack of support for hypothesis 2A and 2B in the dynamic setting actually present a robust view of the dynamic relationship between health insurance markets and medical malpractice insurance markets.

In addition to our variable of interest, we also find that health insurance NPE impact health insurance losses in years $t + 1$ and $t + 2$. The proportion of a state’s population that resides in metropolitan areas, the percentage of the population that is over the age of 65, and the presence of a limit on non economic damages all positively and significantly impact health insurance losses per capita in years $t + 1$ and $t + 2$. The number of persons under the age of 18 per capita is negative and significant in both time periods. Finally, the percentage of a population enrolled in an HMO significantly impacts health insurance claims in year $t + 1$ but not in year $t + 2$.

6. Conclusion
In this paper, we endeavor to analyze and document the relationship between health insurance markets and medical malpractice insurance markets. As such, we develop two sets of competing hypotheses which explain the potential influence each market has on the other. On one hand, health insurance markets may impact the frequency and types of services patients receive from physicians in such a way that physicians’ professional liability exposure, and consequently medical malpractice insurance markets, are affected. However, medical malpractice insurance markets may influence physicians’ perceptions of liability and lead physicians to alter the frequency and types of services given to patients in ways that ultimately influence health insurance markets.

Using claims levels in medical malpractice insurance markets and health insurance markets as measures of services provided by each market, we test the influence of the medical malpractice insurance market on the health insurance market. For robustness, our analysis involves both a contemporaneous and dynamic approach. Our results indicate that year $t$ health insurance claims negatively impact year $t$ medical malpractice insurance claims and also that year $t$ medical malpractice insurance claims negatively impact year $t$ health insurance claims. Further, our multiple period analysis indicates that health insurance losses in year $t$ influence medical malpractice insurance losses in years $t + 1$ and $t + 2$. Thus we find support for our hypotheses in both the contemporaneous model and the multiple period model.

In future analyses, we will continue to evaluate the relation between the markets in ways that allow for a more robust view of the interaction between the markets. Specifically, we plan to include a Granger Causality analysis which will provide more evidence as to the lasting effects each market has on the other. We will also continue to evaluate our empirical models to ensure that our approach, instrument selection, and variable selection are the most appropriate for testing our hypotheses. Finally, we plan to perform state-level natural experiment in Texas and Massachusetts in order to additionally investigate the potential cross over effects of tort reforms and healthcare reform on health insurance and medical malpractice insurance markets.
References


Table 1: Summary Statistics

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<th>Obs</th>
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<td>$12.945</td>
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